Australian Government | Infrastructure Australia

A National Study of Infrastructure Risk

A report from Infrastructure Australia's Market Capacity Program

October 2021

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Section 1

Executive summary

As Australia heads towards an historic level of infrastructure investment, there is evidence of emerging delivery risks across the national infrastructure pipeline

- Australia is witnessing historic investment across transport, utilities, and social infrastructure. In total, more than $300 billion of projects will be delivered in the next 10 years. Spending will peak in 2023 at $45 billion,[1] twice the spend in 2021, and multiples of post-GFC investment.
- The *structure* of the pipeline has also changed. There are nine times more mega-projects, defined as projects over $1 billion in capital cost.
    - Mega-projects can involve higher levels of risk. Oxford Business School analysis commissioned for this study confirms a correlation between the capital cost of a project and its level of schedule and cost risk, in energy and digital infrastructure, and between different types of transport assets. For example, a large Australian energy project over $350 million is more than twice as likely to run over cost than a project under $350 million.
- Market participants in this study observed how the 'volume of risk' increases with concurrent large projects. From an industry point of view, one contractor noted that delivering multiple large projects, each with large sums at risk, left no room for error on their balance sheet.
- This report tests evidence and market perceptions of risk, from contractor failure to increased disputes, to the unavailability of insurance and workforce shortages.
- In addition, this report evidences the emergence of *new* risk categories, such as cyber risk which has grown rapidly, technology risks which create uncertainty around design and commissioning, and policy and market design risks around newer asset classes, such as renewable and waste to energy projects.
- These risks come at a time when the Australian infrastructure sector has had to respond to catastrophic one-off events, including the COVID-19 pandemic, the 2019-20 bushfires and the 2021 floods - which underscore the significant risk environment for major projects delivery.
- This report gauges the level of risk across the infrastructure market over the next five years, the market's appetite for this risk, and whether the approach to sharing of risk is adequate. It compiles evidence, and draws together market and sector insights, to inform its analysis.

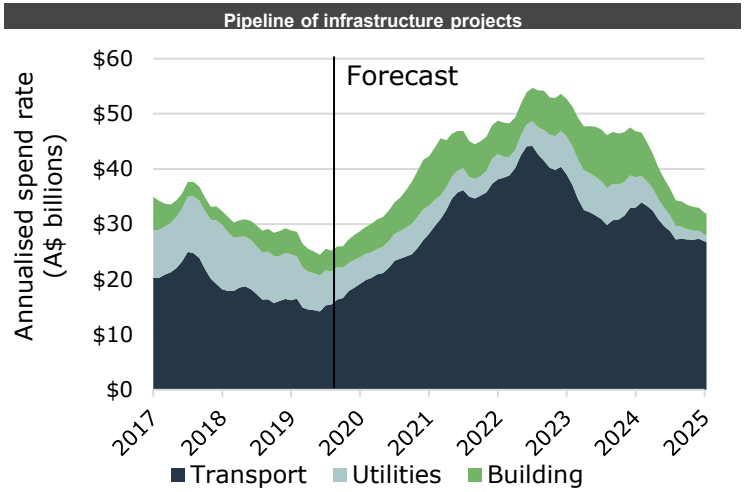


Figure 1: Projected construction activity in Australia

The size and structure of the future infrastructure pipeline poses a growing risk, exposing emerging market constraints and some provider fragility

While the infrastructure sector is confident of managing the growing pipeline of projects, it is less confident about servicing very high levels of growth

Please rate your confidence in your organisation's ability to respond to further growth in the public infrastructure pipeline in the next five years

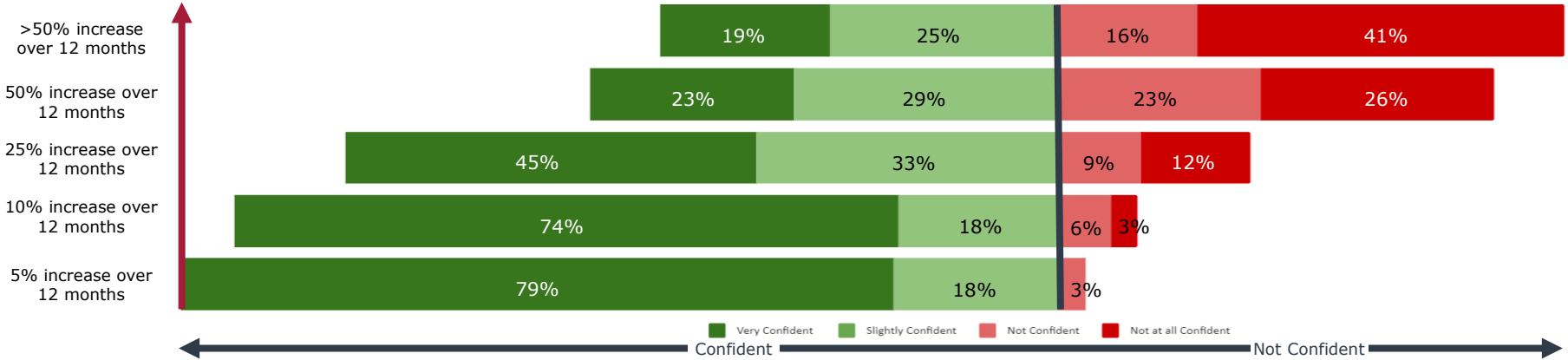


Figure 2: Survey responses on the confidence market respondents had on their organisation's ability to respond to further growth of the infrastructure pipeline.
Source: Infrastructure Australia 2021 Market Sounding Survey

Survey respondents indicated that as the pipeline grows, there is a reducing confidence in their organisation's ability to upscale to accommodate this growth. This trend is relatively linear from a 5% to 25% increase in the pipeline. However, at increases of 25% and 50%, sharper falls in market confidence were observed, with a 26% decrease in confidence. Less than half (44%) of respondents felt confident with their organisation's ability to meet pipeline growth of over 50% within 12 months.

The Australian infrastructure pipeline is expected to see construction spending grow by close to 50% annually during the forward estimates. These results were strengthened in market soundings, where contractors and investors confirmed confidence to manage growth, while noting that the current pipeline contained appreciable risks.

Contractors were most concerned about construction risk, while government agencies perceived contractor and workforce capacity as the greatest current risks

Percentage of Contractor and Government of respondents indicating risks were critical or high

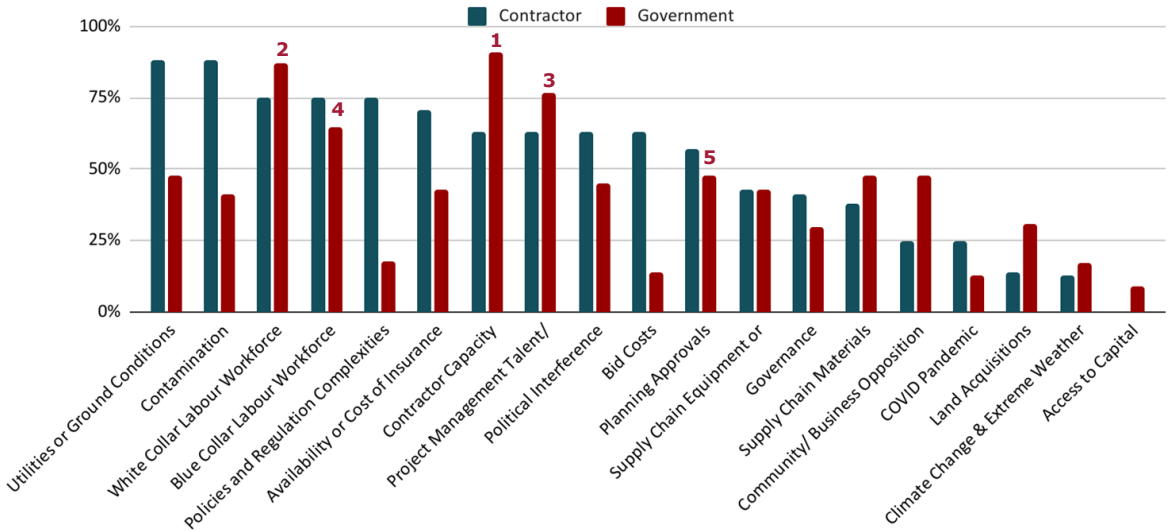
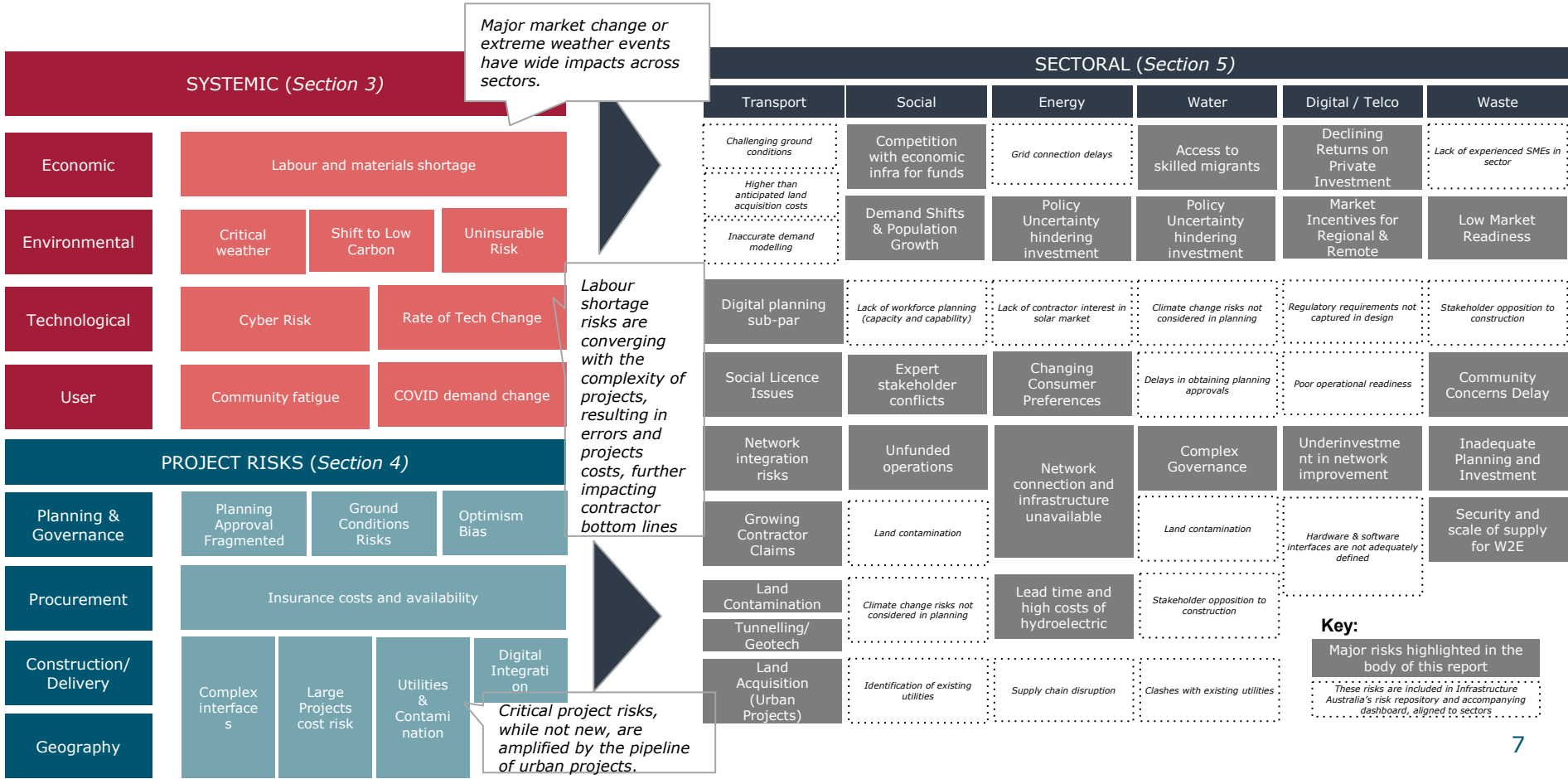


Figure 3: Survey responses on the criticality of different delivery risk, comparing government and private sectors. Graph is in order of contractor risks from largest to smallest
Top five government risk is indicated by the number above the relevant bar.
Source: Infrastructure Australia 2021 Market Sounding Survey

Key Results

- Contractors indicated ground conditions, utilities and contamination as their biggest risks, with a suite of labour risk and insurance/bid costs following after.
- While not as high as the government respondents, contractors indicated their capacity was a risk, indicating both groups appreciate there is a tightness in the market.
- Overall there is an interesting difference in the level of risk perceived by these two groups, with private indicating an overall greater level of risk than government.
- When asked to rate risks in priority order, government respondents cited contractor capacity and white collar workers (eg experienced project managers) as the most critical risks.
- The government respondents, overall, indicated a lower average level of risk rating with only 4 risks being above 50% as high or critical.
- The contractor respondents had 11 risks where over 50% thought they were high or critical.

Systemic factors appear to drive risk 'convergence' across sectors, while common delivery risks are amplified by current conditions, requiring a national response



Many critical project risks, such as ground conditions, are least well understood in early planning and development, the stage when risks are most effectively mitigated

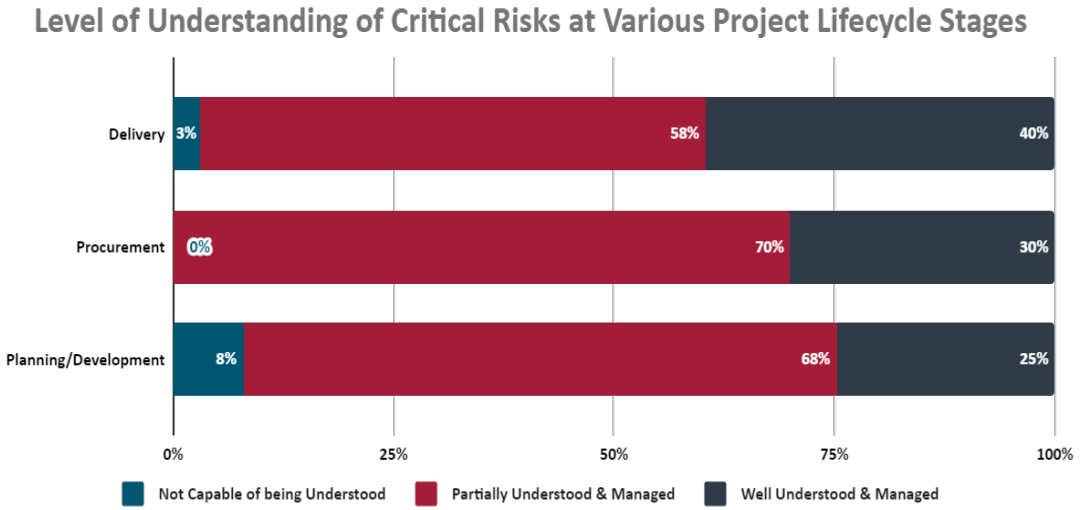


Figure 4: Results from the market sounding survey showing how well respondents think critical risks are understood across the project lifecycle.
Source: Infrastructure Australia 2021 Market Sounding Survey

Key results:

- The majority of market sounding survey responses indicated that risks are "partially understood and managed" across the major phases.
- Confidence that critical risks are understood and can be managed was strongest during project delivery stage, and weakest during project planning and development, where only 25% of respondents felt risks were well understood and managed.
- 8% of respondents considered that critical risks were unable to be properly understood during planning stage.
- On the other hand, industry participants observed that in ground conditions and other risks needed considerable mitigation during planning phase.

Government and private sector participants in the Australian infrastructure sector differ on *who* should bear critical project risks

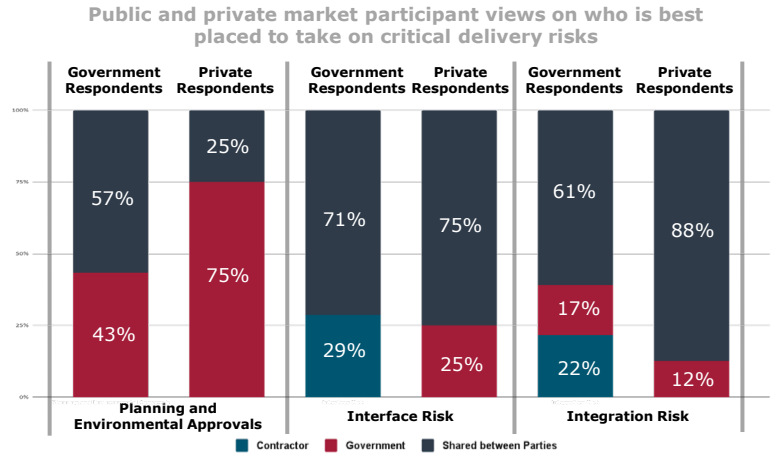


Figure 5: The figure shows who government and contractor respondents think is responsible for planning approvals, interface and integration risk.
Source: Infrastructure Australia 2021 Market Sounding Survey

Survey responses by public and private sector respondents varied considerably around which party should bear interface and integration risk. Private sector participants categorically viewed integration risk as best born by government, while 22% of public respondents suggested private should bear integration risk.

There was agreement that planning and environmental approvals should be either shared or borne by government (public sector). However, 57% of public sector participants suggested the risk should be shared, compared to 25% of private sector participants.

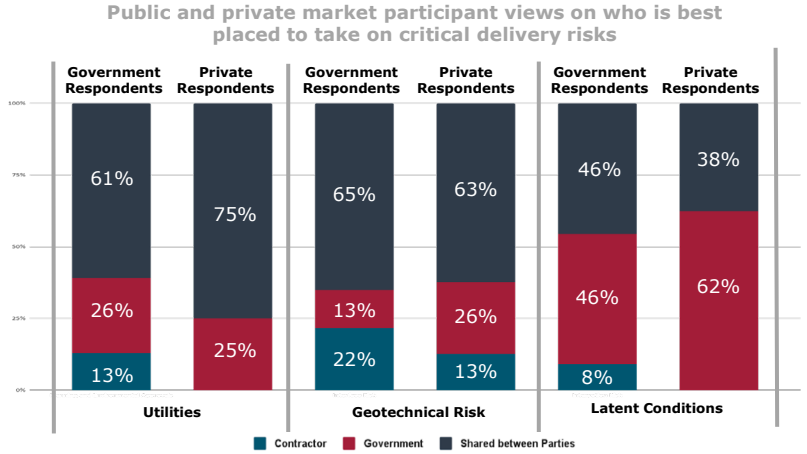


Figure 6: The figure shows who government and contractor respondents think is responsible for utilities, geotechnical and latent condition risks.
Source: Infrastructure Australia 2021 Market Sounding Survey

There is a general consensus between public and private sector respondents that utilities and latent geotechnical risks should be shared. However, 13% and 22% of public sector respondents believed that the private sector should bear utilities and geotechnical risks respectively.

Similarly, with respect to latent conditions risk, no private sector respondents suggested they should bear these risks, in contrast to 52% of public sector respondents suggesting that the risk should be borne by private or shared.

Industry's appetite for risk will be influenced by recent experience and market conditions

The elements considered on this page represent some of the considerations which were seen to be heightening risk, or impacting future risk appetite.

Declining contractor profitability

Tier 1 contractor profits, historically ~4-5%, dropped steeply in 2019, in one case to -7.5%, while winning significant new work.

Rapid decline in professional indemnity

Proponents noted that price of PI insurance had escalated up to three times in two years, with a 50% drop in insurance capacity.

Social licence issues could increase project delays and cost

One report estimates that community opposition to projects over the next decade could amount to a $40 billion cost.[30]

Climate risk impacts on insurance

Insurance premiums in some cases increased by 400% following the 2019-2020 bushfire season.[11]

Cybersecurity risks increased sharply

35% of cyber incidents impact critical infrastructure providers, with one metro water utility observing thousands occur daily.[31]

Cost optimism bias is significant

On the future pipeline, the projected cost uplift required could amount to more than $90 billion nationally.

Price escalation of construction materials

While 2020 ABS data shows rising steel costs, proponents noted acute recent price increases of timber and steel.[22] One lender reported a contractor had an 80-90% steel price increase from tender submission to award.

Labour shortages are evident

Shortages in experienced project managers are evident across all sectors, with 33.5% drop in skilled migration through COVID, and with 40-75% national vacancy rates for critical skills such as civil engineering.[18,19]

Risk transfer and sharing

68% of survey respondents indicated that traditional contracting methods did not adequately manage for emerging risks.

Decarbonisation costs to construction

One estimate is that the cost of decarbonising construction would be 0.4-0.6% of global GDP.[17]

Utilities risk

An estimated 128 projects would deal with utilities risk over the next five years.[2] The Sydney Gateway project will manage 487 utility connection points.

Project complexity and size are a driver of cost overruns in some sectors

Larger energy projects had twice as large cost overruns on average as compared to smaller projects,

By sector, transport and social infrastructure projects comprise 73% of the pipeline, with ground conditions and urban growth requirements driving complexity

TRANSPORT

SOCIAL INFRASTRUCTURE

Recent Major Projects Performance

The Australian market has successfully delivered a growing number of major transport projects in recent years, with Australian transport projects out-performing their comparator projects overseas on cost and schedule outcomes.
Nonetheless, recent project completions and procurement processes such as WestConnex Stage 2, NorthConnex Twin Tunnel and West Gate Tunnel highlight the ever-present concern of ground conditions and growing claims. Industry who were consulted for this report argued strongly that while they are well placed to manage these risks when found, ground conditions over long corridors are 'unknowable' and 'unpriceable' before construction.

Social infrastructure projects tend to break the traditional nexus between project size and project complexity. Sector experts noted that hospital and prison projects for example - large or small - have more complex risk profiles, with complex stakeholder issues, design risk and uncertainty over future operating requirements from policy and technology change.

Wider concerns about contractor experience in a tight infrastructure market were observed as well as ground condition risks. Social infrastructure project risk tends to heighten nearer the point of commissioning.

Critical Risk Assessment

There are 125 major transport projects in the pipeline, representing 58% of pipeline projects in Australia. Over the next 5 years, the Australian market will also be delivering an unprecedented program of rail development, including Inland Rail, Cross River Rail, METRONET, Suburban Rail Loop, North East Link, Melbourne Metro, Gold Coast Light Rail Stage 3 and Sydney Metro.

Therefore, critical risks identified for this sector include:

- **Contamination and cost to remediate:** flexibility is needed regarding sharing and management of risks
- **Urban and community disruption:** community opposition to projects can delay project starts and add cost
- **Tunnelling and ground movement issues:** there will be a 25% increase in tunnelling projects in the next five years
- **Land acquisition:** infrastructure development in brownfield areas that requires surface construction carries additional complexity.

In the next five years, social infrastructure comprises 15% of the project pipeline, with 25 hospital projects under planning, or $17 billion of investment, and new justice, entertainment, social housing and education infrastructure.

The review identified four critical risks:

- **Service, operations and design:** Disconnects to service planning place new hospitals or prisons at risk of delay, stakeholder issues, and redundancy
- **Competition for public investment:** At the point of investment decision and during procurement, social projects are competing with other infrastructure projects for selection, skills and capital.
- **Growth infrastructure:** New building models and significant land acquisition will be needed to deliver infrastructure that meets urban and population growth
- **Technology considerations:** Will disrupt service and provider models and require more flexible (and more costly) asset design.

In water and energy are navigating significant market transition, participants noted that policy uncertainty was a risk to investment and to delivery

	WATER	ENERGY
Recent Major Projects Performance	Delivery of traditional water projects carries mature and known risks. Recent projects include Urannah Dam, Lower Fitzroy, and Pilbara Coastal Water Project. Emerging technology in water and waste treatment has introduced complexities to projects during option selection and commissioning. Projects have seen planning delays and some planning uncertainty with recent climate variability.	The energy investment pipeline is growing significantly, with significant wind, solar and energy storage developments in the five years to 2020. These assets have been impacted by policy uncertainty, which has impacted pricing and value, the timing of grid connection, and on some projects, completion risk. The recent failure of several major contractors is seen by market observers as an indication of new risks not being properly understood or managed. Consolidation of solar portfolios is viewed as an indication of policy and pricing uncertainty.
Critical Risk Assessment	The next five years will see significant water infrastructure development with 15 major projects including dam and water treatment infrastructure.[2] Upcoming projects include Warragamba Dam Raising, South Creek, Urannah Dam, Prospect to Macarthur Link. Critical risks identified in this review include: • **Workforce shortage and contractor availability:** In particular, access to skilled migration is impacting on the delivery of water infrastructure • **National policy uncertainty:** Proponents noted that infrastructure planning and investment risk need a single national water strategy to manage diversity and transition to circular economy water systems • **Governance:** Complex governance arrangements raise project uncertainty within the sector.	The Clean Energy Council predicts there are 98 projects in construction or due to commence soon, representing 10,395 MW and $19 billion in investment.[3] Critical risks include: • **Need for funding and planning of grid infrastructure:** to meet scheduled completion and to manage completion risks for new generation projects • **Policy coordination and uncertainty is discouraging investment:** Market participants indicated that there were global investors who considered the Australian market too high risk on energy policy • **Changing preferences:** Changing preferences from customers and investors are accelerating a structural change in investment portfolios. • **Hydro projects have relatively high risk of cost overruns**

Current market and investment settings are inadequate for waste and telecommunications

WASTE

Recent Major Projects Performance

Relatively few waste projects have been delivered in recent years in Australia, with the Kwinana Waste to Energy Plant being the first such project to be delivered. However, recent national waste export bans and state and national policy development will drive investment in circular and waste processing infrastructure in coming years.

Recent project developments prove ongoing community concern and social licence issues surrounding infrastructure development in this sector, which carries forward into the immediate pipeline of projects.

Critical Risk Assessment

There is a pipeline of around $2 billion in waste infrastructure in Australia, and significant growth is likely as the market adjusts to the waste export ban. Projects are planned and under development, including Swanbank, Australian Paper Energy from Waste Facility, and Parkes Recovery and Energy from Waste Facility.

This review identified critical four risks:

- **Inadequate infrastructure planning and development:** the pace of planning and development is not yet sufficient to meet the level and type of demand that a circular economy requires
- **Community concerns:** projects have been deferred or rejected due to community concerns and social licence
- **Security and scale of supply:** waste to energy requires bankable feedstock volumes, which are difficult to consolidate and to transport
- **Low market and regulatory readiness:** technology adoption and regulation do not yet have the right incentives for timely investment.

TELECOMMUNICATIONS AND DIGITAL

Recent Major Projects Performance

The NBN (revised) build was completed in 2020, with NBN Co reporting that the build provided successful connecting of over 11.86 million premises, and around 100,000 complex premises yet to be made 'ready to connect' (RTC), expected to be reduced to around 35,000 as at 31 December 2020.

While the roll out was subject to policy and design changes, and late construction deadlines, the overall construction build was delivered reliably. In 2020, additional capacity was released to ISPs during the lockdowns to meet increased demand from working from home activity.

Critical Risk Assessment

NBN Co made a recent commitment to deliver the next 'targeted' phase of investment and network improvement by 2023. A program of $4.5 billion will deliver improved wholesale speeds for 75% of homes and businesses in the fixed-line footprint, invest in initiatives with retail internet providers, and support state and territory partnerships in regional and remote Australia. This will occur alongside state government 'Gigabit program' initiatives and private sector investment in 5G and mobile connectivity.

The review identified some critical risks:

- **Underinvestment and poor affordability:** The size of planned network investment is insufficient to meet policy objectives around universal regional and remote access
- **Lack of market incentive in rural and remote areas:** underinvestment in regional infrastructure due to commercial models
- **Declining returns on investment and 'free rider' issues with 5G:** risking optimal investment in 5G.

Delivery risks were observed to have geographic dimensions, with thin market issues in Northern Australia and remote areas, and heightened complexity in urban areas

Key risks (0-5 years)

Developing Regions and Northern Australia

Within Developing Regions and Northern Australia the risks relate to access to land claims, labour, materials, energy and water.

- **Native title:** there is a notable exposure to native title claims on greenfield sites for infrastructure development. This process can add 3-4 years before a project can begin and create barriers to investment.
- **Electricity and water:** in these areas, access to critical items like ground water and energy can be challenging. As an example, Newman (WA) uses the electricity provided by mining companies and before any major public infrastructure requiring energy were to begin, new baseload power would be required.
- **Labour and materials:** there are challenges in accessing materials and labour particularly resulting from competition with mining and resources companies.

Small Towns, Rural Communities and Remote Areas

Smaller Towns, Rural Communities and Remote Areas have challenges of access to labour and materials similar to Northern Australia.

These towns and communities also face similar challenges in securing contractor workforces to their regions for planned construction activity.

There are two risks that were highlighted for this place type:

- **Ensuring access to operational skills:** there is a risk that infrastructure is built in these regions that do not have the skills and equipment to operate or maintain.
- **Digital access:** given the expanse of regional Australia, some areas do not have broadband access or mobile coverage, this puts these regions at disadvantage regarding the potential adoption and deployment of digital engineering and other modern techniques.

Smaller Cities and Regional Centres

Smaller Cities and Regional Centres were not called out by experts and organisations as having significant, unique risks.

Major contractors indicated that getting access to staff in smaller cities and regional centres was relatively easy, given the desire for people to live in these locations.

What was identified though was risk in attracting contractors given smaller jobs:

- **Contractor attraction to smaller work programs:** this was identified as a risk to infrastructure projects in these areas, which tend to be smaller in size and without a clear pipeline of future work in the area, it can be challenging to get a contractor of sufficient size to bid and complete the work.

Fast-growing Cities

Within Fast-growing Cities the risks relate to the urban environment and associated complexities with ground conditions, utilities and disruption to local communities during construction.

Some risks that were identified include:

- **Contamination and cost to remediate:** flexibility is needed regarding sharing and management of risks.
- **Urban and community disruption:** growing fatigue from projects can delay project commencement and delivery and add cost.
- **Tunnelling and ground movement issues:** there will be a 25% increase in tunnelling projects in the next five years with potential impact to above ground structures from ground movements and associated claims.
- **Land acquisition:** infrastructure development in brownfield areas carries additional complexity.

National risk data and reporting, market capacity reforms, and risk assessment and best practice procurement could support better risk management in the next five years

While Australian projects typically apply a mature approach to managing risk, with significant data captured by projects, the understanding of risk across the pipeline of infrastructure is varied and incomplete. The activities below outline elements for a national response to better monitor, report and manage risk.

BETTER DATA

The availability of risk data across the infrastructure pipeline is a major constraint in the way Australian governments can manage across sectors and projects:

- **Build National Risk Register:** continue to develop the National Risk Repository.
- **Further build risk mapping capability:** The current risk map could be developed in successive stages if desired, to enable near real time mapping of climate and spatial risks and their impacts on networks. This would complement the resilience focus of the National Resilience and Resilience Agency, Australian Climate Service and others.
- **Open-source hazard and climate risk data:** standardise and publish national climate data and scenarios, including hazard maps.

MARKET CAPACITY

The single most critical factor in meeting the coming pipeline of projects will be ensuring the sustainability of Australia's contractor market:

- **Identify options for supporting scaled growth for tier 2 and 3 contractors.** While measures are being done by individual agencies, shared learnings are required across jurisdictions.
- **Undertake a review of the market conditions for infrastructure insurances:** the harden professional indemnity insurance market is a major constraint on consultants requiring action.
- **Northern Australia and remote infrastructure:** skills attractions remains challenging for remote regions, with limited options. These regions face further challnges associated with access and availability to data for decision-making.

NATIONAL PROJECT RISK ASSESSMENT

Better project risk assessment will need to be applied both during project planning and post project delivery:

- **Streamlined planning and approvals:** Referral pathways between state and Commonwealth planning should progress to completion.
- **Develop and update a National Risk Framework:** adopt a common format for project assessment and post-completion risk capture for IPL projects.
- **Pipeline planning:** continue regular reporting to National Cabinet on market capacity, including supply chain, and workforce and risk requirements.
- **Broader use of reference class benchmarking and forecasting** or similar methods which assess cost and schedule outcomes post project completion, and apply these on future projects.

BEST PRACTICE PROCUREMENT

Proponents noted the impact of an engaged procuring client, who sought to understand market capacity and to engage market participants, bringing embedded expertise to the delivery of the project:

- **National contract and design standardisation:** Precedents abroad include the NEC and Fiddich standards, RIBA design stages.
- **Managing design risk early:** Leveraging best practice approaches to engaging stakeholders, practitioners, and users early, as well as engaging contractors.
- **Best practice packaging** of major projects to maximise competition and market capacity.
- **Update guidelines to incorporate collaborative contracting** and develop alternative risk sharing models.

Section 2

Introduction to the report

The recent COVID pandemic, natural bushfires and floods prompted National Cabinet to expand the role infrastructure plays in supporting economic recovery

The past two years have seen widespread disruption to the Australian economy and to its infrastructure sector from extraneous events:

- The COVID-19 pandemic triggered lockdowns, which drove economic recession, with negative GDP growth of 0.3% and 7.0% in the last two quarters of 2020 (FY).
- Australia suffered its most costly natural disaster to date, the 2019-20 bushfire season, with one estimate of the damage to be over $100 billion.
- The Queensland floods in 2010-2011 cost the Australian economy an estimated $30 billion.[13]

Australian governments responded by initiating major infrastructure stimulus and rebuilding efforts:

- The infrastructure sector established 'critical services' status for construction projects, leading to construction activity quarterly growth in the last quarter of 2020.[4]
- The National Bushfire Recovery Agency was established, and state agencies established recovery and investment programs.
- Stimulatory investment was committed to accelerate the delivery of roads, water, and other projects.

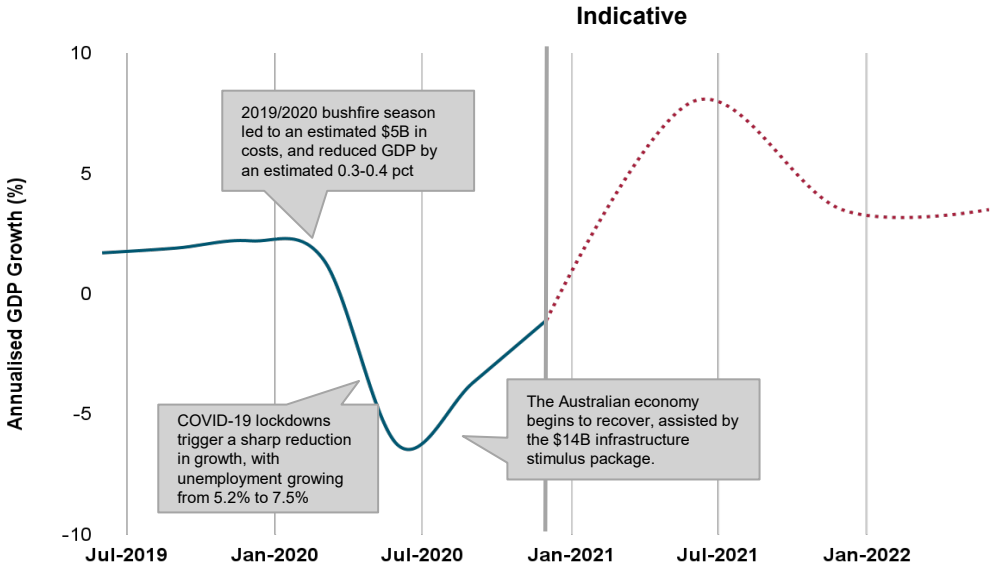


Figure 7: Annualised GDP growth per quarter.
Source: Department Treasury Finance, 2021

Unprecedented infrastructure investment is planned for delivery in the next five years, which is well timed, but nonetheless, has some risks to successful delivery

Australia's infrastructure pipeline is its largest ever, with more than approximately **$300B+** of projects planned for delivery over the next 10 years. The pipeline is due to peak in 2023 with over double the current construction spend in 2021.

The infrastructure sector has also highlighted the extent to which the *structure* of the pipeline has changed, with investment in emerging asset classes such as renewable energy, and a ninefold increase in complex and major projects over $1b in size.

While the timing of this pipeline of spending is supportive of stimulus and rebuilding efforts, there is evidence that these factors together amount to a more complex risk environment over the next 0-5 years, and that a systematic approach to risk will be critical to the effectiveness of economic recovery.

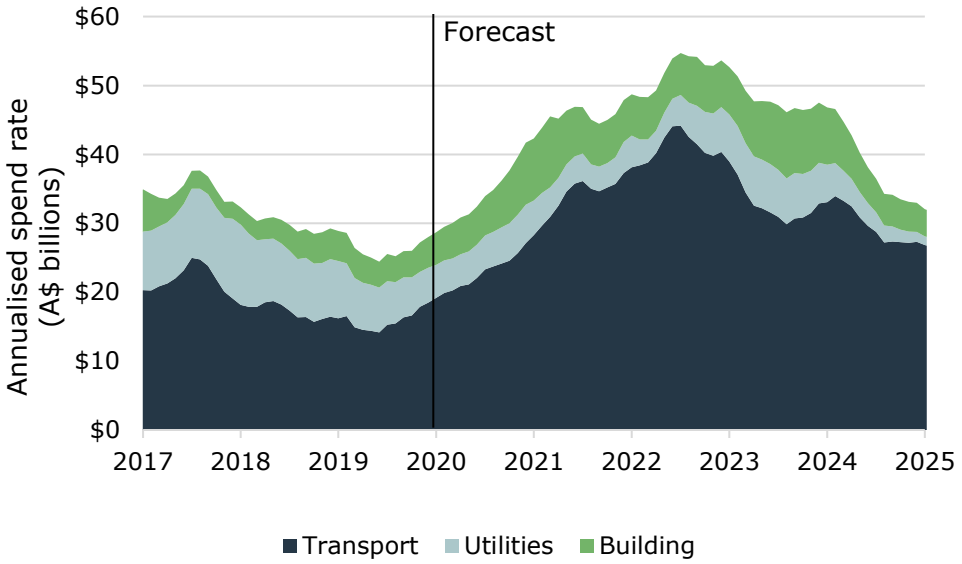


Figure 8: Projected construction activity in Australia

A national focus on infrastructure risk has developed in recent years, with increasing capability within governments to assess risk across sectors and projects

This report builds on the significant work which has already been underway across national and state governments in order to improve the planning and delivery processes, and to mitigate risks across the infrastructure delivery lifecycle. Ths reports seeks to build on existing work and provide a broad, national view on infrastructure risk. This work includes, but is not limited to:

Infrastructure Australia 2019 Audit
This report identified seven future trends which pose a risk to the way people will interact with infrastructure into the future, which covers areas of environmental sustainability, economic, population, and labour force changes, quality of life and cost of living, and the development of new technologies.

CSIRO National Outlook 2019
This report explored the six main challenges facing Australia over the coming decades, of which some will impact infrastructure usage and demand, including climate change, technological change, the ageing population, and social cohesion.

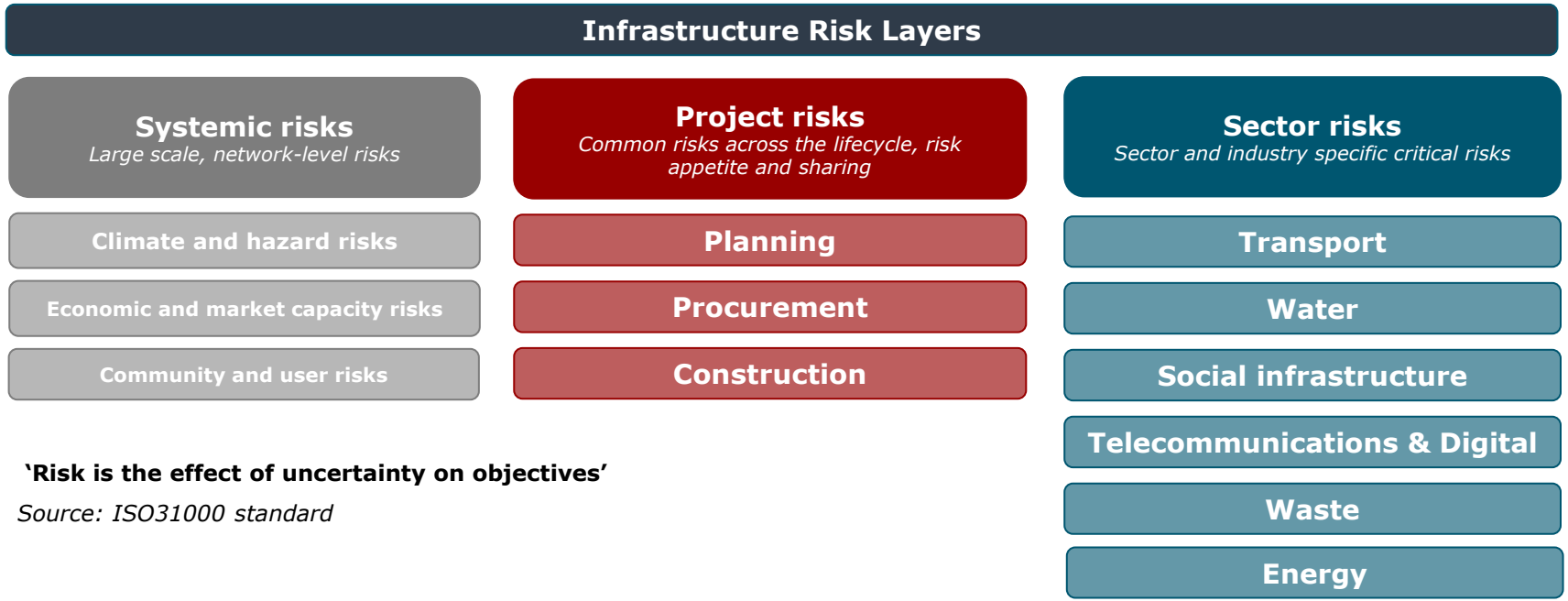
Department of Home Affairs Critical Infrastructure Resilience Strategy
Developed a number of strategies to protect Australia's critical infrastructure, such as hospitals and electricity networks, from external threats which can manifest through supply chains, data security, cyber attacks, and security breaches.

Infrastructure Australia *Infrastructure beyond Covid-19*
This report identified five key trends brought about by COVID which are having an impact on infrastructure use and which include: digitisation of the workplace, decentralisation in demand for utilities and infrastructure, greater use of local infrastructure, innovative service delivery in schools, health and the workplace, and the adaptability of infrastructure to meet demand.

National Recovery and Resilience Agency
A national program aimed at bringing together government and non government entities to help in response to natural disasters such as bushfires and floods, and to assist in the development of infrastructure in communities affected by these disasters.

State Infrastructure Bodies
Many state bodies, including Victoria's Office of Projects, Major Projects Canberra, NT Infrastructure Commission, Infrastructure Victoria, Infrastructure NSW, Infrastructure SA, and Infrastructure WA have assisted in streamlining infrastructure planning and approval processes, supporting key infrastructure projects, and assisting teams in both government and industry involved in the infrastructure development process.

This report examined the current risk environment for infrastructure delivery across three layers; systemic risks, project risks and sector risks



'Risk is the effect of uncertainty on objectives'

Source: ISO31000 standard

Figure 9: Visual representation of the research approach used in this report. Risk was broken into three categories with interview questions framed within the risk framework (page 24).

A program of research and market consultation informs this report

1. Broad Review: Macroscopic Lens

A macroscopic review of 'systemic' risks to the infrastructure pipeline was conducted.

- A review of 19 Australian risk-related datasets was undertaken.
- Analysis drawing on the Oxford Global Projects' global and Australian project dataset to benchmark cost and schedule overruns. The database includes over 11,000 projects valued at US$3 trillion.
- Risks identified were examined for impact, likelihood, direction and manageability.

2. Detailed Review: Microscopic Lens

A detailed analysis of risk-related project documents to build the evidence base for recent project risks.

- Review of publications, recent project business cases, ANAO and state Auditor General reports and project risk registers across transport, energy, water, social, waste and digital projects.
- Risks were assessed, with more than 150 risks compiled in a risk repository under the risk framework.
- A digital mapping tool was developed to store the risk repository and to identify its geospatial dimensions where possible.

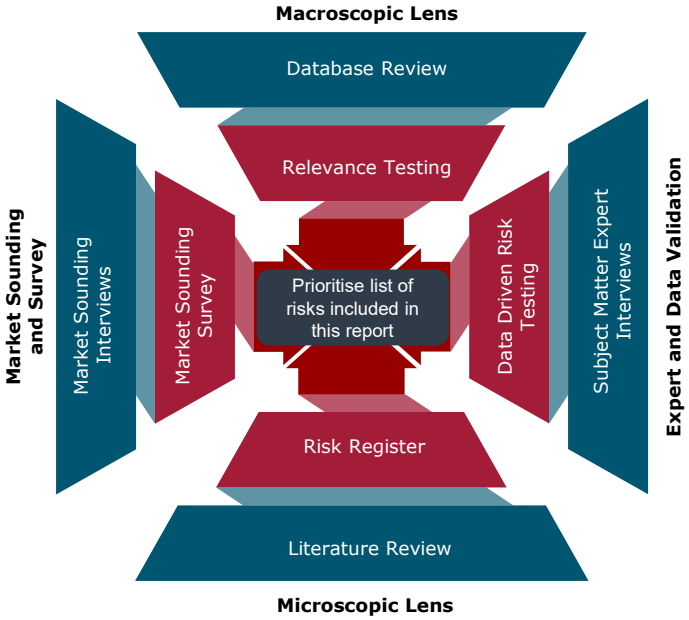


Figure 10: Visual representation of the methodology used throughout this report. The macroscopic and microscopic components have been highlighted.

3. Market Sounding and Surveys

A consultation to test emerging views within the infrastructure sector on critical risks, risk appetite and risk sharing was undertaken.

- A market sounding was conducted, with senior leaders from 37 organisations in the infrastructure sector being interviewed.
- This was followed by a sector survey which collected the views of 40 senior infrastructure executives.
- Consultation was undertaken withpublic procuriong and delivery agencies, banks, equity investors, Tier 1 and 2 contractors, and insurers to calibrate the identified risks to the current market.

4. Expert and Data Validation

Initial consultation and findings validation were undertaken throughout the project.

- The validation tested informed risks and initial findings with sector-based, subject matter experts.
- Over 70 expert interviews were conducted with government executives and the PWC Infrastructure team across renewables, transport, energy, water, social, waste and digital sectors.

The risks included in this report use the below risk rating and trend approach, based on the detailed risk assessment framework

As risks were identified through reviews of project registers, expert interviews and market soundings, we sought to test them against the five criteria aligned to the risk framework outlined earlier - **Impact, Likelihood, Rating, Trend and Manageability**.

For the purpose of the risks and risk themes outlined in this report, we have used a simplified risk assessment framework, comprising a risk rating (based on likelihood and impact) and a trend (showing the direction of the risk).

Risk ratings were identified based on risk likelihood and impact definitions that have been developed for Infrastructure Australia. Importantly, different organisations have different risk appetites and definitions for what would constitute these ratings (i.e. Low, Medium or High). We have made an attempt to 'normalise' these for the purposes of a National Risk Assessment framework. For more details on the definitions, see Appendix section **6.4 Risk Taxonomy**.

Risk rating:

- **Low** - risks that can be managed through routine procedures
- **Medium** - risks that require active management and regular monitoring, without which they could become high or critical
- **High** - risk that exceed project risk tolerance and requires priority management
- **Critical** - risks that require immediate escalation and focussed executive/board/ministerial effort

Risk trends are also identified (**decreasing, stable or increasing**) to identify whether the risk will become more prevalent over the course of the next calendar / financial year period.

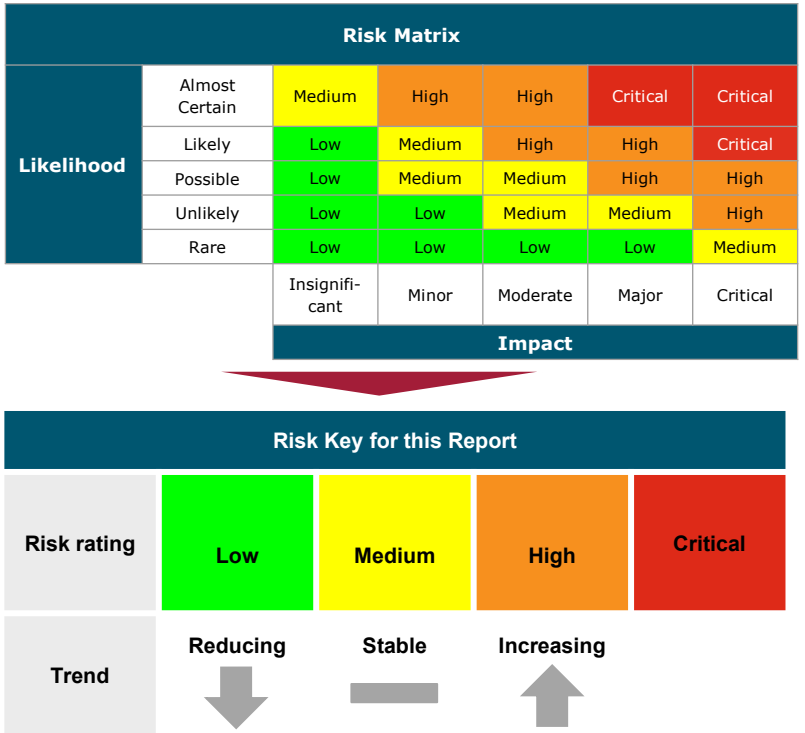


Figure 11: All risks in this report were assessed and assigned a rating against the risk key.

The risk assessment approach was developed and used to assess risks and develop an initial national repository of infrastructure risks that will be developed over time

A National Risk Assessment Framework has been development based on ISO standards and definitions, it was developed to apply to the three major risk layers. The framework also drew on best practice risk management process.

In addition to the development of a risk framework, a risk repository was created from the review of risk registers and reports, compiled across sectors to provide an indicative list of recent risks impacting on infrastructure projects.

This risk repository will be dynamic and updated over time as projects are completed, to support ongoing learning on infrastructure risk. The repository has been used as the input data for part of the visualisation tool developed to support this report.

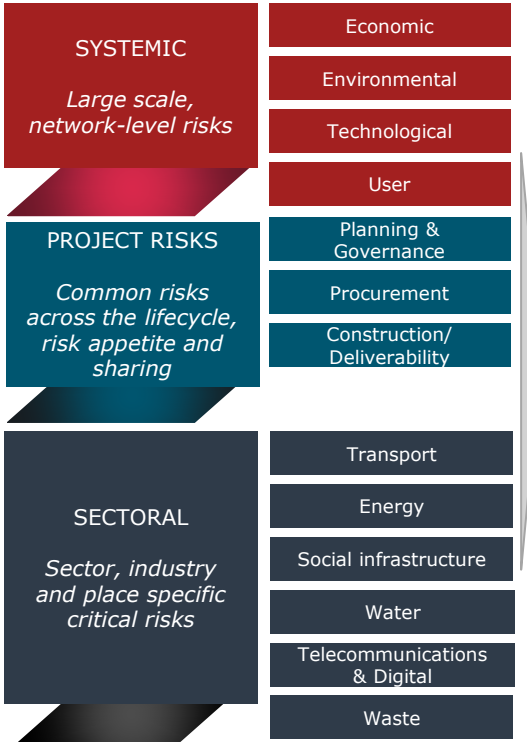
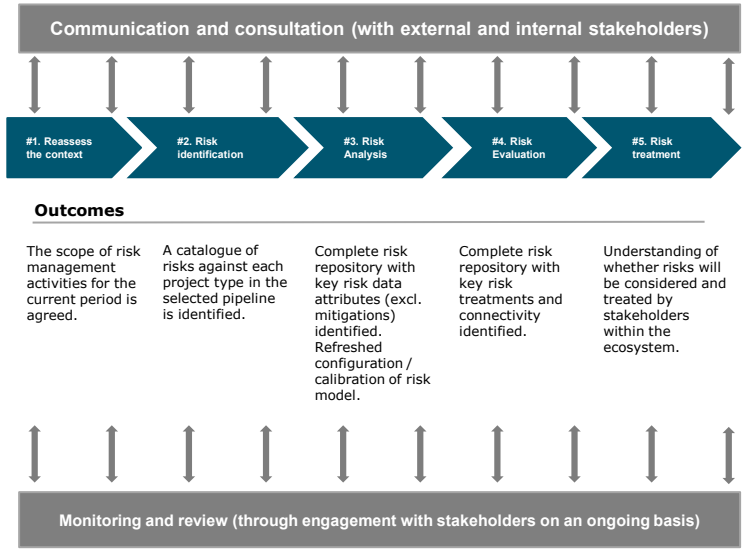


Figure 12: The risk assessment process used as the framework to develop this report.

Risk assessment process



A risk visualisation tool was developed to show climate and project risks in the repository

This first version of the tool provides insight into climate risks, and provides access to the project risk repository using a series of filters.

There is an opportunity to further develop this tool, to inform project planners of locational and project type risks, and could be developed with real-time updating capability to support network management of disruptive events, for example.

In preparing this online tool, various datasets were identified for use, including:

- Bureau of Meteorology
- CSIRO
- State planning departments
- National Bushfire Recovery Agency
- Geosciences Australia.

The Department of Agriculture, Water and the Environment, alongside the Australian Climate Service, have recently commenced work to improve the sharing and compatibility of these data sets.

Importantly, these data sets still show significant variation between jurisdictions in the way climate risk and flooding risk, for example is captured, making it difficult to compare.

Improvements to the quality and consistency of climate data would enable better resilience planning and management.

Guide to online risk visualisation tool

Select particular regions on the map to show their applicable risks.

What are the specific locations of the climate risks?
Select which map layers to show from the drop-down menus.

Risks have been mapped to the four Infrastructure Australia 'places'.

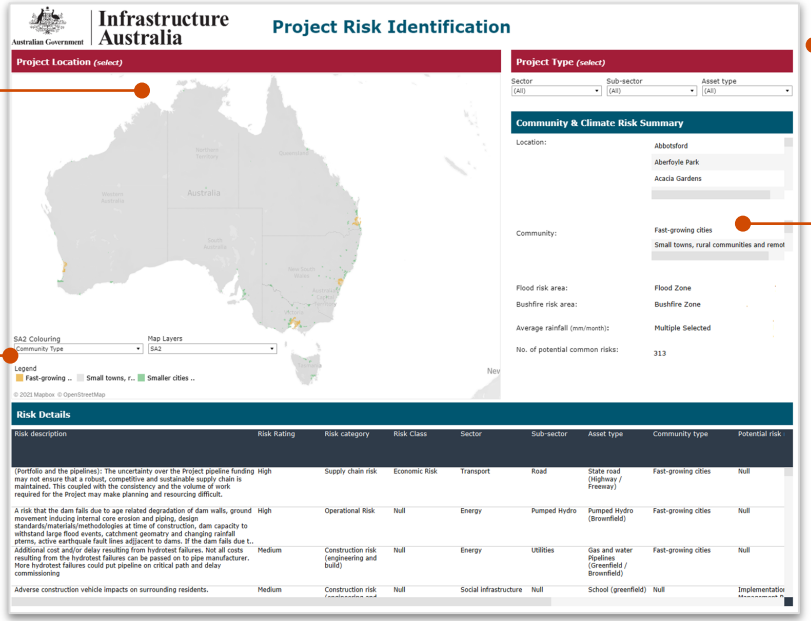


Figure 13: Visualisation tool

Select project attributes to filter for relevant risks and locations.

What climate risks are present?
Information about a selected region/s is displayed.

What specific risks are relevant to my location/s?
Select a risk to highlight the applicable locations on the map.

Applicable risk information for different regions, sectors, subsectors, and asset types are presented in the table.

The review of recent project risk registers, reports and business cases, also took into account the different risk profiles of projects in different locations in Australia

	Developing Regions and Northern Australia	Small Towns, Rural Communities and Remote Areas	Smaller Cities and Regional Centres	Fast-growing Cities
Infrastructure Priority List	**8 projects** specifically targeted at developing regions and northern Australia, which are focused on improving transport and freight links, water accessibility, and energy infrastructure in the regions.	**26 projects** are planned, with a focus on road, water, and telecom infrastructure.	**49 projects** are planned, with a major focus on roads and transportation.	**76 projects** are planned over the coming years, spanning across all sectors, but with a major focus on public transport, roads, and energy.
	In addition there are also **21 national projects** and programs that span across the transport, waste, social infrastructure, energy, and water sectors.			
Number of Identified Risks	**19 risks** were identified that are prominent in Small Towns, Rural Communities and Remote Areas. These risks were also prevalent in Developing Regions and Northern Australia. These risks included project planning, project management, and stakeholder risks across the transport sector.	**13 risks** were identified which was unique to the Smaller Cities and Regional Centres. This region heavily overlapped with Fast-growing Cities in terms of the risks present in infrastructure development.	**125 risks** were identified across recent projects in Fast-growing Cities. These risks spanned across the transport, energy, health, waste, and water sectors, and covered risks across the lifespan of infrastructure projects.	

* Note: Data as of May 2021

Section 3

Systemic risks for Australian infrastructure

Infrastructure is extensively exposed to systemic risks - large scale and extraneous events and conditions that impact on multiple types of infrastructure

Systemic Risk: Assessment Overview

- A significant contributor to risk levels for infrastructure delivery is the extent of external and systemic risk.
- This section establishes the major systemic risk categories (climate, market capacity, social and technology) and assesses 10 specific risks and their impacts on cost, schedule and benefit outcomes for infrastructure projects.
- Analysis in this section is drawn from desktop and data analysis, research of Australian and global databases, and market interviews and consultation with subject matter experts
- Importantly, this section highlights that systemic risks are drivers of multiple project risks, from planning through to delivery to operation, have cross-sectoral implications, and are influenced by national and international conditions.
- This 'convergence' of risks, where a single systemic change results in cascading impacts across networks and projects, would suggest that systemic risks are difficult to mitigate effectively at the level of individual delivery teams. For example, labour shortages, extreme weather events, and reduced insurance access, may involve workarounds at project level, but nonetheless, will require more extensive consideration by governments.

Category	Description	0-5 year assessment	
		Rating	Trend
Climate and Natural Hazards	Increasing extreme weather events and a changing climate represent a risk to major network infrastructure.	**Critical**	
	The global shift to a low carbon future will impact infrastructure design, delivery requirements and the supply chain, increasing costs.	**High**	
Economic and Market Capacity Risks	Labour shortages are identified as a current and significant future risk, delaying projects and increasing costs.	**Critical**	
	The contractor market in Australia has grown, however there is fragility relating to financial sustainability and concentration.	**Critical**	
	Evidence suggests significant infrastructure pipeline is impacting cost of materials and will increase as the pipeline grows.	**High**	
	Amidst growing insurance costs are a group of uninsurable risks due to climate, COVID and complexity which governments need to accept.	**Critical**	
Community and User Risks	COVID is resulting in lasting changes in both living and working patterns as longer term population growth changes underpin demand.	**Medium**	
	Social license issues and community fatigue are leading to additional project costs and delays.	**High**	
Technology and Cyber Risks	The increasing reliance on technology within infrastructure is resulting in greater cyber security risks.	**Medium**	
	Failure to accommodate for design for new and emerging technologies pose a risk to asset investments and usage.	**Medium**	

Critical weather events and a changing climate are a critical risk to major network infrastructure

Impact Critical

Trend

The increasing intensity and frequency of adverse weather events poses an episodic but extreme risk to developing and to existing infrastructure, including in the near term.

- Australia has seen a 40% increase in bushfire frequency between 2011 and 2016. The 2019-20 bushfires caused upto $100 billion in damage, including $5 billion worth of road damage.[9]
- Rainfall is increasingly volatile, with extreme drought and flooding in parts of the country.[10]

From an infrastructure perspective, the focus is on adaptation and resilience building, with a number of key risks identified:

- Climate change stakeholders highlighted the lack ofstandardised, centralised and transparent data to support planning
- Climate resilient infrastructure can be built by incorporating this data in developing structural adaptations, such as changing the composition of road surfaces so they do not deform in high temperatures
- Management adaptations can also be made during operation, such as to maintenance

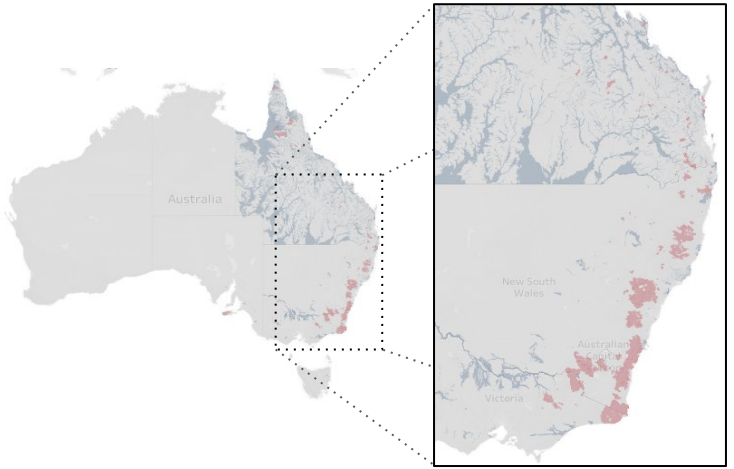


Figure 14: Flood and bushfire risk map

400%

Insurance premiums have increased by 400% in some regions following the 2019-2020 bushfire season.[11]

$5b

The 2019-2020 bushfire season resulted in $5 billion in direct damages to road infrastructure.[12]

$30b

The total cost of Queensland floods in 2010-2011 resulted in over $30 billion in damages.[13]

The shift to Environmental, Social and Governance outcomes will change investment and involves transition risks

Impact High

Trend

Industry participants, especially investors and financiers, pointed to evidence of a recent and rapid shift towards Environmental, Social and Governance (ESG), with investment appetite for sustainable projects pushing ahead of regulatory requirements. This evidence includes:

- A number of banks have announced a net zero policy and carbon budgeting for their lending portfolios, with more expected to follow in coming months
- Recent oil and gas infrastructure deals which have struggled to get finance.

Nonetheless, participants noted that the pace of energy transition and implementation of transition strategies involve additional burden and complexity. Uncertainty over future regulatory and market settings, due in part to changes in Australia's climate policy (see Figure 15), 'cannot be hedged' and therefore represent a risk to investment and delivery.

With 70% of Australia's greenhouse gas emissions associated with infrastructure projects,[14] the shift to ESG will also have implications for construction, as materials supply chains are decarbonised within the 0-5 year timeframe.

38%

38% of CO_2 output globally is produced by the construction industry.[16]

0.5%

0.5% of global GDP will need to be invested annually in clean energy transistion, to achieve net zero emissions by 2020.[17]

"Total annual energy investment [will need to increase] to USD 5 trillion by 2030" - International Energy Agency

*estimates based on the global energy sector hitting net zero emissions by 2050[15]

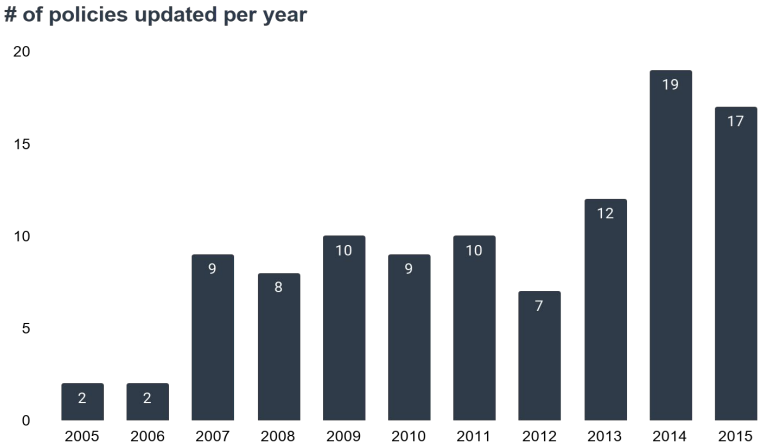


Figure 15: Number of new and amended changes to climate policy made from 2005-2015.

Labour shortages are a significant risk to project delivery schedules and costs

Impact Critical

Trend

- Shortages of senior managers and field labour are a critical risk to the delivery of a fast-tracked infrastructure pipeline, and are likely to worsen within the 0-5 year timeframe.
- Local risk shortages have been compounded by the COVID-related 33.5% decline in skilled migration in the construction sector, compounding a shortage of civil engineers and surveyors nationally.
    - Pre-COVID data indicated shortfalls already existed in critical skills areas with migrants critical to meeting this gap.[18,19]
- Industry participants spoke of their experience of getting the "D Team and E Team", on high risk projects where "grey hair actually counts".
- Skills shortages can lead to poorer risk management practices, mistakes during cost planning, lower construction productivity and higher levels of re-work, and can require firms to partner with unfamiliar or poorly matched teams.
    - One contractor observed a correlation to a higher incidence of non-conformances, saying that "we're finding more and more mistakes" on projects.
    - A utility observed the growing risk of burnout for senior managers, and the issues of having risk situations where teams are working above their experience levels, leading to costly mistakes.
- With the pandemic still of a critical concern globally, it is estimated that global travel may not return to pre-COVID levels before 2024, one year after the projected peak construction period.[20]

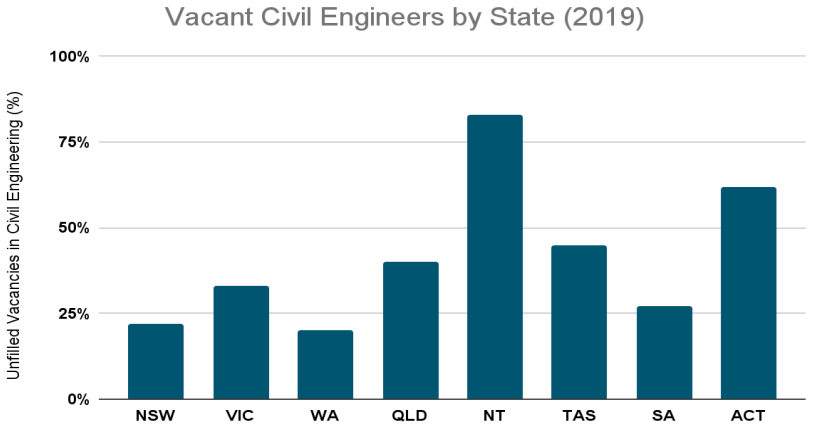


Figure 16: Vacant civil engineering positions by state in 2019.
Source: Department of Education, Skills and Employment, 2020

'Labour hours for particular blue collar activities have more than doubled due to the experience levels of the workers and managers'

Interview, Subject Matter Expert

'50% of the North-South Motorway (South Australia) project management team have been poached for competing infrastructure projects'

Interview, Subject Matter Expert

The contractor market in Australia is experiencing a 'profitless boom', with balance sheet risk and low margins posing a structural market risk

Impact Critical

Trend

- The Australian market comprises a small set of Tier 1 contractors, who saw sharp declines in profitability from 2018-2019. The implications of an insolvency scenario for competition are significant.
  - Lendlease sold part of its engineering business following the cost blow out on WestConnex.[21]
  - In the UK, the insolvency of Carillion, whose major projects encountered difficulty and increased debt levels, is a potential warning about how much risk can actually be transferred to the private sector.
- The 'unaffordability' of risks to contractor balance sheets from the pipeline of megaprojects was viewed as a recent phenomenon.
  - A simple comparison of the 'volume of risk' at stake between a 10% cost risk on a $200m project versus a $2 billion project, underscore the heightening risk where a contractor may be delivering multiple mega projects at once.
  - A contractor noted that "the numbers are huge and people can't get their heads around it".
- The resulting increase in joint venture bids creates additional risk from interconnectedness across the market.
  - This implies a market structure akin to the Australian banking sector, whereby major contractors may be "too big to fail".
- Competitive cost pressure to have the 'cheapest price' on the D&C component of a project bid may contribute to optimism bias and a situation whereby risks are not well-priced.

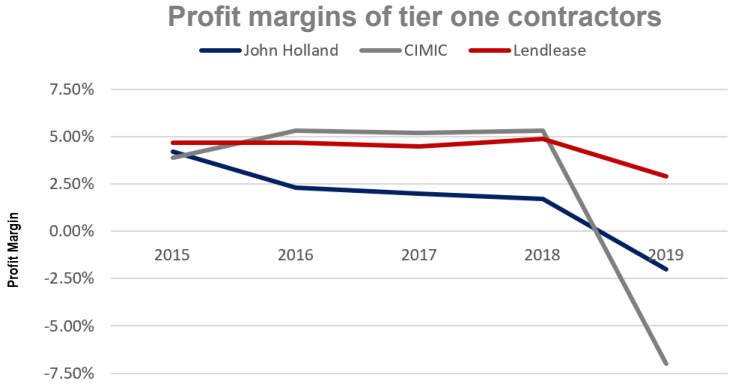


Figure 17: Profit margins for tier one contractors John Holland, CIMIC and Lendlease have all seen to rapidly decline in 2019 .
Source:John Holland, CIMIC and Lendlease 2015-2019 annual reports

Case Study: WestConnex and Lendlease

The high risk of cost blow-out and reducing profit margins, lead to companies such as Lendlease taking on more financial risk. A cost blow on WestConnex has forced Lendlease to sell part of its engineering business to Acconia for $180 million in 2020.[21]

*Westconnex is a 33 km motorway network which spans across Sydney, while Stage 3 is the development of connections to the M4 and M5 Motorway

Growing demand is leading to cost and availability constraints for materials and supplies

Impact High

Trend

The cost of materials such as iron and steel is forecast to peak within the next two to three years, as demand from civil and residential construction grows. This represents a risk to the timely delivery and cost of infrastructure projects.[22]

During market consultations, interviewees implied that current reported data understated emerging constraints.

- A contractor indicated they are experiencing increases in the price of cement which has doubled over the past few years.
- A bank reported that its contractor's cost of steel had increased 80-90% between bid submission and award
- A contractor noted that sourcing concrete and quarry materials was more difficult, increasing the costs of transportation which comprise an estimated 40% of the total cost of concrete
- A contractor noted that availability of quarry stone and steel were uncertain, timber was being redirected to serve strong building demand in the United States, and shortfalls of locally produced laminate timber were evident since COVID.

The specifications for materials can also change with new requirements during tender, allowing a very short period of time to work with the supply chain to arrange changes. This risk is converging with overall price rises and significant uncertainty in ground conditions to create the potential for significant underestimation of costs for projects.

Data Volatility

Figure 18: Projected price of iron and steel.
Source:IBIS World, 2021

The COVID pandemic, bushfires, northern cyclones and recent storm events are creating 'uninsurable' risks

Impact Critical

Trend

One insurer noted that the past few years had seen "lots of black swan events" in quick succession. The pandemic, floods, bushfires and even cyber attacks involved a single extreme event generating many losses at once, and increasing loss factors and interruptions risk for many.

The annual level of insured losses for weather related events shows exponential growth from the beginning of this century, to more than $4 billion in 2011.

Further the increasing severity and frequency of natural disasters in Australia has resulted in exponentially growing insurance payouts which are being passed through to insurance premiums for following years.

As these climate risks worsen, becoming more frequent and causing greater damage to the built environment, insurers may no longer be willing to insure infrastructure, housing and buildings in high risk regions, or will only be able to insure them at affordable rates. This could create insurance "red zones" across Australia, as has already been occurring in recent years.[24]

Governments have traditionally tried to push as much risk as possible onto the private sector [which] has led to a high numbers of claims for time delays and quality issues.[23]

Consult Australia

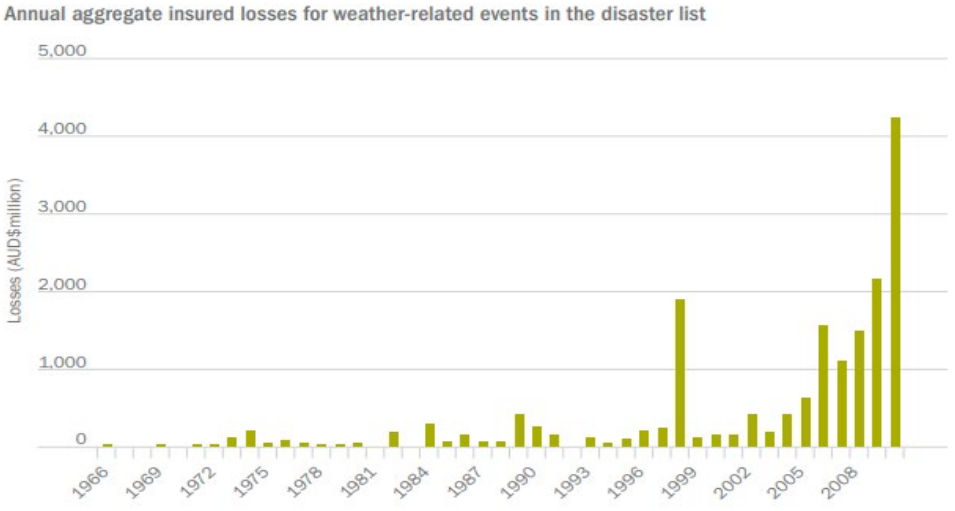


Figure 19: Department of Infrastructure and Regional Development graph on the increasing levels of insurance payouts for natural disasters.
Source:Department of Infrastructure and Regional Development, 2014

AECOM rejected projects every week due to the rising cost of insuring them.[23]

AECOM

COVID is resulting in changes in both living and working patterns as longer term population growth changes underpinning demand

Impact Medium

Trend

The impact of the COVID pandemic on infrastructure risk has three dimensions, and is moderate overall in the 0-5 year timeframe:

- **Reduced worker movement and migration.** While migration is expected to return, reduced migration through COVID has reduced the expert workforce available for certain projects and reduced the expected size of Australia's population by the equivalent of a city the size of Adelaide, as can be seen in the graph of the government's population forecasting.[25]
- **Supply chain requirements.** These were most evident early in the pandemic, however, builders did report a significant impact on project delivery from state lockdowns, a motorway project had to open without panels which were unable to be transported during the pandemic, and contractors reported the heightened need to diversify supply lines. One contractor noted that many supplies, even those manufactured in Europe for example, still transited through China, raising concerns around supply chain resilience
- **Infrastructure demand.** COVID may have lasting impacts on how infrastructure is used, for instance, a mode shift in transport, changes to municipal infrastructure use, and a growing reliance on communications infrastructure. As such it is possible that lasting demand impacts from COVID-19 will underpin infrastructure use over the next five years and beyond.[26]

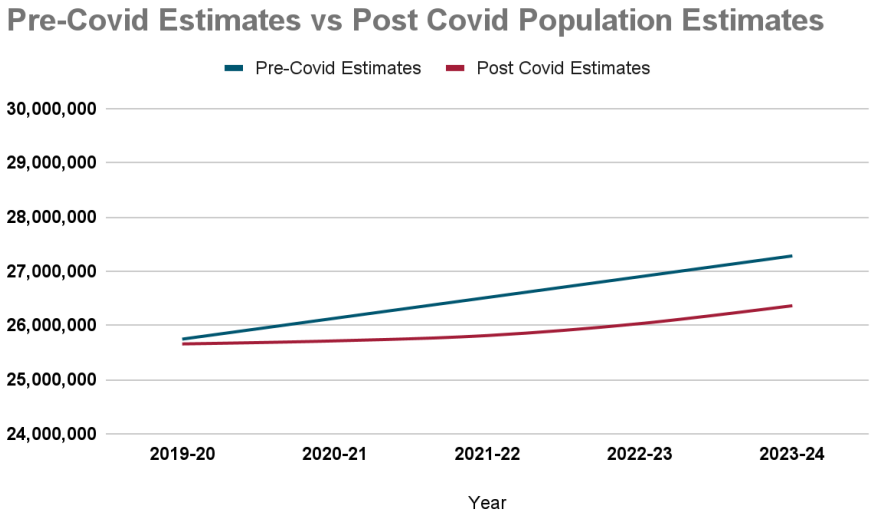


Figure 20: Population Forecasts

Source:Centre for Population, 2020

Social license issues and community fatigue are leading to additional project costs and delays

Impact High

Trend

Industry participants engaged as part of the market sounding pointed to major cost and project delays that resulted from community opposition to infrastructure projects, and community 'fatigue' with construction.

71% of Australia's population living in major cities will be impacted by projects in the forward-looking infrastructure pipeline.[2,27] The result is that many of the country's most complex engineering projects also experience high levels of community opposition and concern.

The concept of Not-In-My-Backyard (NIMBY) is a major hurdle for projects within urban areas, as locals pushback against the localised impacts of city-shaping projects.

Examples of recent project cancellations highlight the challenge of managing social license issues. It is estimated that $20 billion worth of infrastructure has been cancelled over the last decade as a result of community opposition.[30]

This risk can be reduced, however it requires a strong community involvement and coordination across projects to ensure projects are completed quickly and with minimum disruption to the communities impacted.

Early project announcements, overly specific details in announcements and optimism bias in planning stages are setting unrealistic expectations of project delivery times in some cases, and these can fuel community opposition where there are perceived delays.

Case Study: Melbourne Skyrail
Initial apprehension from local communities over the proposed Melbourne Skyrail, included concerns over noise, property values, pollution, environmental damage, and maintenance expectations of the infrastructure. However, these issues were addressed in the design and maintenance of the Skyrail, such as through erecting noise barriers and fixing drainage issues around the parks. This has led to many residents seeing the new overpass as a net benefit to the community due to improvements in local traffic and greenspace.[28,29]

Case Study: Eastern Creek Energy from Waste
In 2017 a large scale waste-to-energy plant in Western Sydney faced strong community opposition due to fears of health risks and pollution, which contributed to the project failing to receive planning approval. Ultimately a lack of community engagement about the facility and its impacts on the environment and local region contributed to the failure of the proposal.[30]

$20b

Previous decade - estimated historical impact from community oppositions.[30]

Impact Medium

Trend

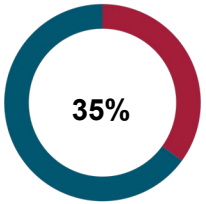
The increasing reliance on connected technology within infrastructure is resulting in greater cyber security risks

There has been a substantial increase in cyber attacks in recent years, with over 2000 cyber security incidents reported in 2019, and over 1,000 of these targeting government and critical infrastructure providers (see Figure 21).[31]

Globally cyber attacks have resulted in the disruption including the attack on Johannesburg's electricity grid, the 2015 disruption to power facilities in Ukraine and the 2017 Triton attacks on Saudi petrochemical facilities.[32]

Cyber security risks have the ability to have extreme impacts on infrastructure. Our growing dependence on technology and the need to embed connected technology into infrastructure means this risk will continue to grow.

This risk can be reduced by strongly considering cyber security risks at the planning stage and investing in security measures.



Of cyber incidents impacted critical infrastructure providers.[31]

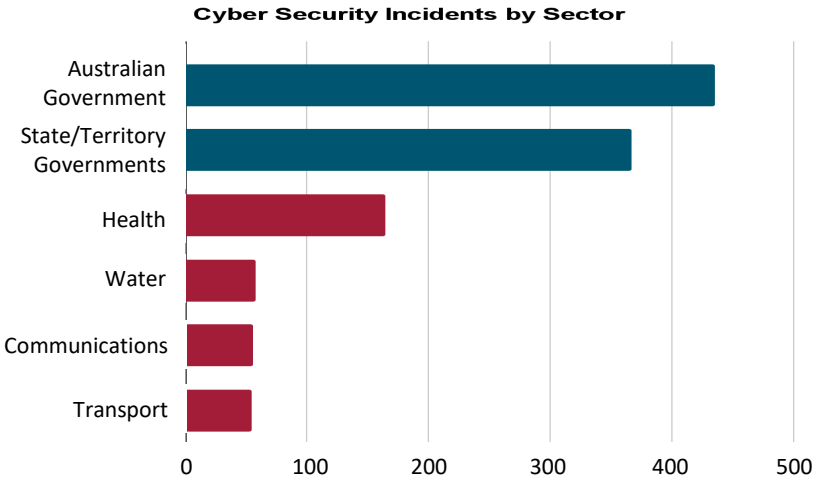


Figure 21: Number of reported cyber security incidents in 2019.
Source:Annual Cyber Security Threat Report, 2020

Case Study: Colonial Pipeline

In May 2021 Colonial Pipeline, one of the largest gas pipelines in the US, fell victim to a ransomware attack, which led to the pipeline being shut down until a $5m ransom was paid. This resulted in a state of emergency being announced for 17 states due to potential fuel shortages.

Impact
Medium

Trend

Failure to design for new and emerging technologies pose a risk to asset investments and usage

Technology continues to grow at an accelerated pace

Whilst it is difficult to predict the technologies which will define the future, the continued acceleration of the internet of things (IoT), increased consumer control of infrastructure use, shared assets and rise of automation are all rapidly growing trends which will likely define the next 30 years and pose a moderate risk to infrastructure obsolescence.[34]

Given the immense investment made in infrastructure development, it is important to protect infrastructure from obsolescence.

As such infrastructure will need to be designed to be more technologically adept. Poorly integrated infrastructure will be most at risk of lower than expected demand, risking a benefit underrun and reduced economic viability of infrastructure.

Therefore the failure to design for new and emerging technologies pose a low risk to the infrastructure over the pipeline, however this risk will grow with time, thus decisions need to be made at the planning stage to future proof infrastructure in a technological world.

8%

Only 8% of construction companies globally categorise themselves as technologically adept.[33]

The inability to effectively design for emerging technologies limits the potential benefits of infrastructure and reduces their effective lifespans.

Without costly retrofitting, infrastructure which is not being to adapt to future technology will be at risk of large benefit underruns.

Section 4

Project risk sharing and risk appetite

While some project risks are unchanged, in-ground conditions and contractor risks are growing, and may lead to lower willingness to share these risks

Project Risks: Assessment Overview

- There is a long list of common project risks, however, current industry views on which risks are critical reflect recent project experience and confidence in the deliverability of the forward pipeline. Generally, the principle on who is best placed to bear a risk reflects consideration of who has greater *control* over the risk or its mitigation.
- This section identifies **eight project risks** across the early stages of the infrastructure lifecycle that are currently 'top of mind' for sector participants, and captures stakeholder views on changing risk appetite and approaches to risk sharing. It also draws on evidence of major factors behind schedule and cost overruns on Australian projects, namely optimism bias and approval process delays.
- Importantly, a major finding is the prevalence of critical risks during construction phase on urban projects, such as geotechnical risks, in-ground conditions, and utilities risks, as well as integration and interface risks that increase the complexity of projects, and result in greater cost overruns and delays. These would appear to be amplified by recent major projects and the forward pipeline.
- Section 3 was developed using market soundings and interviews with over 70 subject matter experts, and a survey of senior executives within the infrastructure sector, both covering large and small contractors, insurers, investment funds, and government bodies.

Category	Risk name	Desciption	0-5 year assessment	
			Rating	Trend
Planning & Governance	Optimism bias	Optimism bias in cost estimation is creating budgetary constraints and delivery risk as cost pressures mount in delivery.	**Critical**	
	Planning approvals	Cumbersome and fragmented planning approval processes are slowing down projects and adding costs	**High**	
Procurement	Insurance	The capacity in the insurance market has significantly dropped with increased premiums and reduced coverage.	**High**	
	Project scale and complexity	As projects get larger the increased complexity results in more frequent and proportionally larger cost overruns.	**High**	
Construction & Delivery	Utilities relocations	Utilities relocation risk will continue to be a key issue in the delivery of the infrastructure pipeline with potentially significant consequences	**Critical**	
	Technology integration	Integration risks is increasing due to new infrastructure projects and technologies requiring integration into existing systems	**Critical**	
	Ground conditions	Unpredictable ground conditions can lead to significant impacts during project delivery and	**High**	
	Interface	Interface risk is becoming more pronounced with the increasing size, scale and complexity of the infrastructure pipeline	**Critical**	

Market sounding interviews indicated confidence across the sector in the Australian market, but highlighted emerging capacity constraints

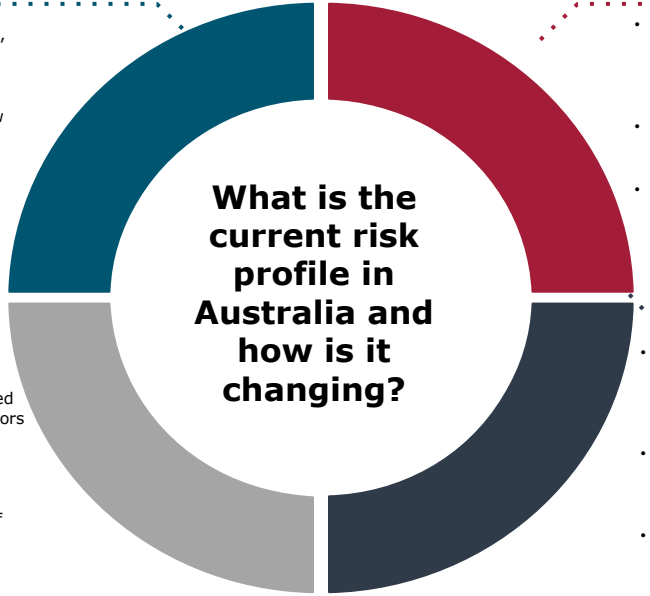
Market sounding interviews were conducted with 40 organisations, with a summary of each segment captured below

Banks and Lenders (Debt)

- **Liquidity is Strong:** Whilst the infrastructure market is heavily banked, respondents highlighted there was plenty of capital available, with 20-25 banks participating in the provision of funding.
- **Contractor risks:** Contractor risk remains the biggest risk factor when providing debt to infrastructure. The growing size of projects means few Tier 1 contractors are capable of bidding, however competition means profit margins are reducing despite contractors taking on more risk.
- **Sovereign risk:** Despite project cancellations and policy changes, lenders agree sovereign risk is not a deterrent from investing in Australian infrastructure.
- **Strong ESG Focus:** Clients demand visibility around how Environmental, Social and Governance (ESG) policies are applied into their investments. This has seen reduced liquidity in industries such as coal.

Contractors

- **Market capacity:** The increased size and scale of projects, have limited the number of participants who can compete on a project, yet contractors are experiencing a 'profitless boom'. Increased risk is driving joint ventures. Critical market exposure would occur in the event of a single contractor failure.
- **Resourcing constraints:** There is a limited capacity for Tier 1 contractors to bring their 'A team' to each project due to the volume of projects concurrently running in Australia. This poses a threat to the quality of such projects.
- **More sophisticated risk sharing is needed:** The volume of megaprojects in the pipeline requires a more sophisticated approach to risk sharing, as commissioning, interface, resourcing and completions risk become more pronounced



Funds (Equity)

- **Capital deployment:** Investors are taking ESG considerations more seriously within their portfolios, this sector is growing quickly. However, capability to assess and manage risk in new asset classes is still developing and market and policy frameworks are still uncertain. ESG opportunities are undervalued.
- **Need to refocus on public value over lowest price:** When prices are pushed too hard to win contracts, there is a higher risk of claims, and less sustainable behaviours that involve 'playing the contract'.
- **Case for rebalancing risk allocation:** The heavily leveraged infrastructure market in Australia has made capital deployment difficult due to the limited voice that equity may have in the investment. There is a case to rebalance debt/equity ratios due to the size of infrastructure projects and the growing risks contractors are taking on with lower profit margins.

Insurers

- **Tightening Market Capacity:** Concurrency across projects, a large number of claims, and a reduction in global provider capacity, with syndicates pulling out and less profitable portions being culled, has put pressure on pricing and policy coverage. Coverage capacity is dropping potenitally by 50% and premiums are increasing significantly over the past 2 years.
- **Contractual Frameworks:** Insurers are encountering contractual arrangements that introduce additional insurance requirements and costs, eg provisions for Delays in Start Up (DSU), Product Specific Professional Indemnity and Warranty or Guarantee protection.
- **"Lots of black swan events" in the past 2 years:** Significant interruptions from COVID, and catastrophic weather events have driven a large number of claims, with high loss factors. This has driven scrutiny of cost/price adequacy.
- **Cyber risks are growing:** There was a significant increase in 12 months of claims, across the project lifecycle, with large market losses.

While critical risks tend to be less well understood during planning, many construction and delivery risks are best mitigated during the planning phase

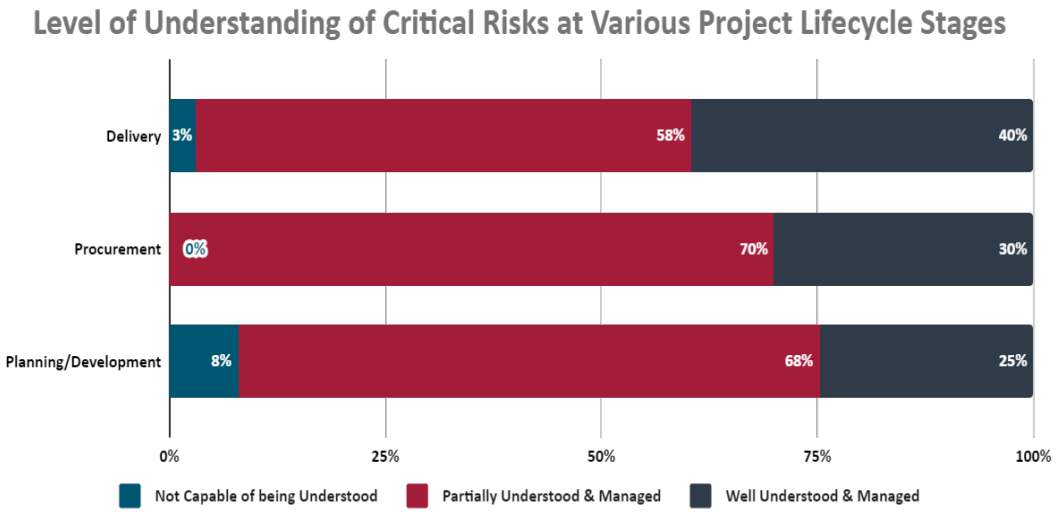


Figure 22: The extent to which market participants believe critical risks are understood across the project life cycle.
Source: Infrastructure Australia 2021 Market Sounding Survey

According to those surveyed, the current 'top five' critical risks in the infrastructure sector are:

- Contractor capacity
- Labour shortage across blue collar, white collar and managerial positions
- Utilities and ground condition risks
- Availability and cost of insurance
- Contamination risk, utilities and ground conditions.

Figure 22 shows that survey participants viewed critical risks as least understood during planning and development, and best understood during delivery.

8% of respondents considered that critical risks were unable to be properly understood during planning stage.

Nonetheless, contractors observed in consultation that 'unknown elements' such as in ground conditions must largely be mitigated during planning phase.

For example, a bid on Sydney Light Rail that had priced for hundreds of potential utility connections would have been seen as unlikely to be competitive.

Impact High

Trend

Mega-projects tend to involve greater project complexity, resulting in more frequent and proportionally bigger cost overruns

The number of large projects (over $350m and over $1b) has risen in recent years, increasing ninefold over the decade.

Oxford analysis of projects across energy, road, and digital/IT projects has found that globally, larger projects (valued at $350m or more) are more likely to face cost overruns, and proportionally larger cost overruns, than smaller projects. Their analysis of Australian projects is statistically comparable.

Globally, large energy projects had twice as large cost overruns on average compared to smaller projects. This trend continued when looking at projects of $1b or more as compared to projects of between $350m and $1b. This relationship also held for IT projects.

However, on average large road projects were not more prone to overrun than smaller ones, with both having an average 30% cost overrun. This partially conflicts with some industry preconceptions which suggest that as the size of Australian road and rail projects increased so too did the likelihood and size of cost overruns. It is important to note that the Oxford dataset while large does not include very recent transport projects from Australia.

Large projects tend to have bigger cost overruns towards the extremes of the distribution. This finding is corroborated by Grattan research which found that over one third of transport cost overruns since 2001 were driven by just seven megaprojects, which overestimated benefits and underestimated costs due to optimism bias and project complexity.

The primary exception to this trend are social infrastructure projects, such as hospitals and prisons, where projects' stakeholder, design, and policy risks can be complex regardless of size.

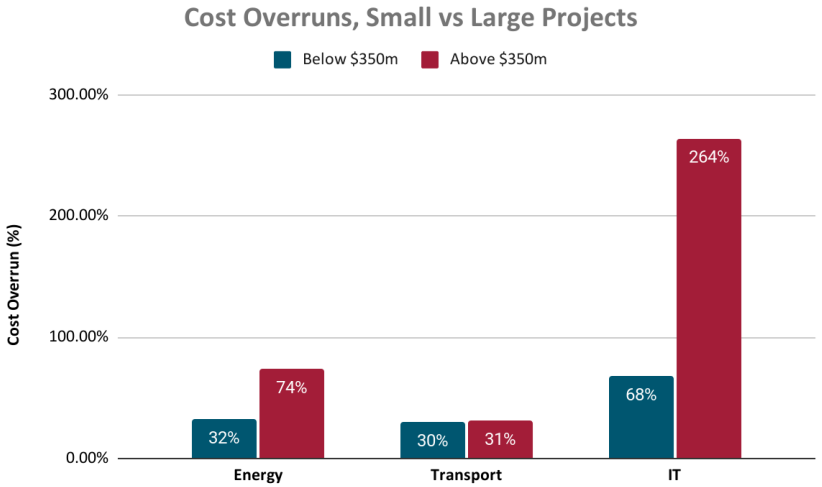


Figure 23: As projects get larger, the proportion of the cost overrun also increases.
Source: Grattan Institute, 2020

Major cost overruns are attributable to shortcuts in planning and optimism bias

Impact Critical

Trend

While planning and pipeline visibility has improved since the establishment of infrastructure bodies and publication of infrastructure plans, research continues to find optimism bias in project costs, schedules, and benefit forecasts at all project stages.[35]

Optimism bias can manifest during the planning and business case phase, or during project procurement, e.g. with risk ultimately borne by government. This can lead to:

- over-estimation of net benefit results in cost-benefit analysis;
- the actual costs of delivering a project exceeding the forecast expected costs, leading to budgetary stress;
- an erosion of the public's confidence in infrastructure planning, assessment and delivery processes;[36]
- insurance or compensation claims or claims for further funding from government.

Globally, according to analysis by Oxford Global Projects, optimism bias uplifts in Transport projects range from 60-80% of the cost of all road and rail projects, with cost or schedule overrun and benefits shortfalls against the base case. Oxford Global Projects indicated that Australian projects were statistically similar to global findings, with similar cost curves.

This research advocates for:

- Improved pre-tender Project Development and Due Diligence (PDDD) can reduce the level of uncertainty in design development (e.g. ground conditions)
- Techniques such as 'reference class forecasting' to remove optimism bias and develop more accurate forecasts.

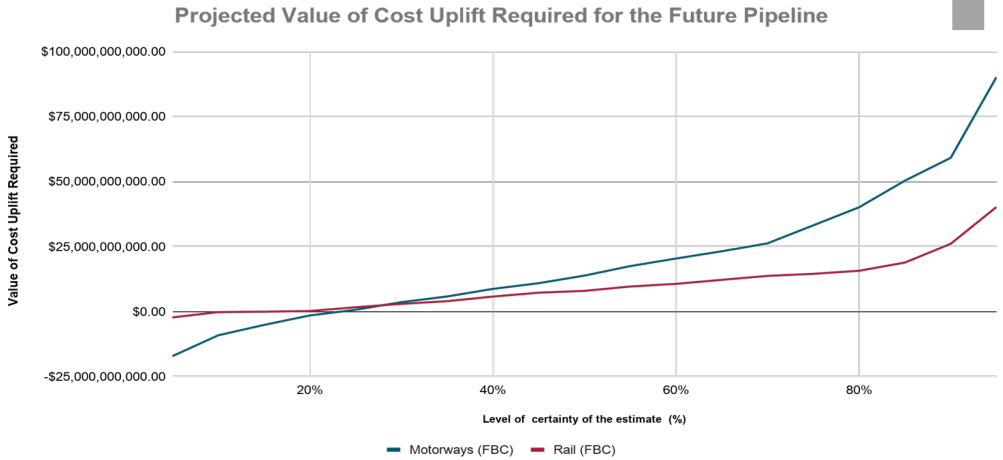


Figure 24: Based on an analysis of 144 urban rail projects and 977 motorway projects, statistical analysis of the difference between the final business case and actual cost of the project is used to deduce the potential cost uplift required at various certainty estimates on the future infrastructure pipeline for motorways and urban rail. NB - these projects are global but are statistically similar to Australian projects and therefore the curves are the same.
Source: Oxford Global Projects, 2021

Approval processes for major infrastructure projects are cumbersome, fragmented and involve multiple layers of approvals across government

Impact High

Trend

Contractors and investors viewed planning and environmental approval processes as an unpredictable risk to project timelines and a driver of delay. The need to coordinate across multiple layers of government to obtain approvals, and the requirement to meet increasingly onerous conditions attached to many approvals, (e.g. in relation environmental approvals) prompted concern over delivery times.

The sector survey brought to light differences between government and private sector participants around who should take on risks around planning approvals. Of private sector respondents, three-quarters felt this was a government responsibility, compared with 43% of government respondents.

While slow planning and approvals is not a new issue, the scale of the upcoming infrastructure pipeline will magnify its impacts nationally.

Planning and environmental approvals are typically shared by state and private sector parties. Key approvals are typically obtained by the state, with minor and technical approvals allocated to the contractor. Issues arise where:

- Key decisions around design requirements are not made early in the process and mandatory approval requirements are unable to be clearly defined and articulated. This creates a risk that the final design is likely to have elements requiring rework after contract reward, leading to potentially significant time and cost overruns.
- During delivery some smaller approvals require the contactor to consult or obtain consents from numerous stakeholders, where it can be argued that the State can more easily manage.

Public and private market participant views on who is best placed to take on planning approval risks

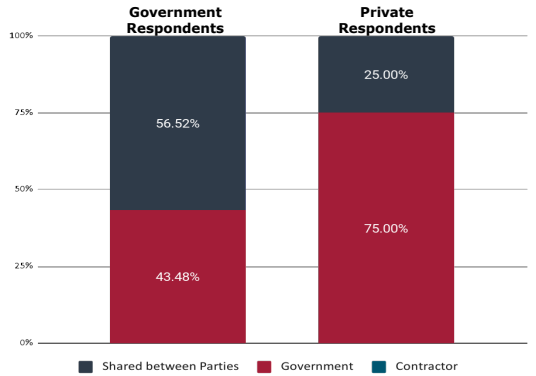


Figure 25: The figure shows who government and contractor respondents think is responsible for planning approvals.

Source: Infrastructure Australia 2021 Market Sounding Survey

Risk sharing - market sounding insights:
There is significant divergence between government and contractor respondents on who should carry planning and environmental approval risk, with 75% of private indicating that government should solely carry planning risk compared with only 43% of government respondents. 57% of government respondents thought this should be a shared risk, compared with 25% of private. This risk is becoming more prevalent as the pipeline grows, requiring an approach that is supported by both parties and reduced the risk over delays and costly compensation claims.

Utilities relocation risk will continue to be an issue in the forward pipeline, with potentially significant consequences

Impact Critical

Trend

Utilities relocation risk represent a significant risk in the delivery of major projects, in particular given the number of brownfield projects in developed areas with multiple and varying utility infrastructure that is often not well mapped or able to be easily identified. Accordingly, it is often difficult to price accurately.

This risk is challenging for any project party. Market soundings indicate that traditionally government clients have sought to transfer this risk to the private sector. However the ability for any party to effectively manage this risk is limited by the absence of any meaningful commercial incentives or bargaining power that can be leveraged in negotiations with utility companies.

Private sector participants have limited means to manage utility company demands and can often be forced to absorb the pricing and program implications of any demands. However, given the likely magnitude of time and cost delays in the context of the current infrastructure pipeline, we are likely to see a trend where the market will either not accept this risk, or engage in disputes with the client in order to recover significant losses.

The well publicised dispute between the contractor and the state government on the Sydney CBD Light Rail demonstrates the significant cost and schedule impacts of managing such risks. The resulting cost overrun was in the order of $1 billion, or around 50% of total project value. In addition, service commencement was delayed, for which the contractor brought claims against the government.

However, some headway is being made to mitigate risks associated with utilities relocations. For example, early works packages have proven effective in mitigating this risk. In particular, those early works packages procured under collaborative contracting models may be a useful mechanism for minimising the risks associated with utilities relocation.

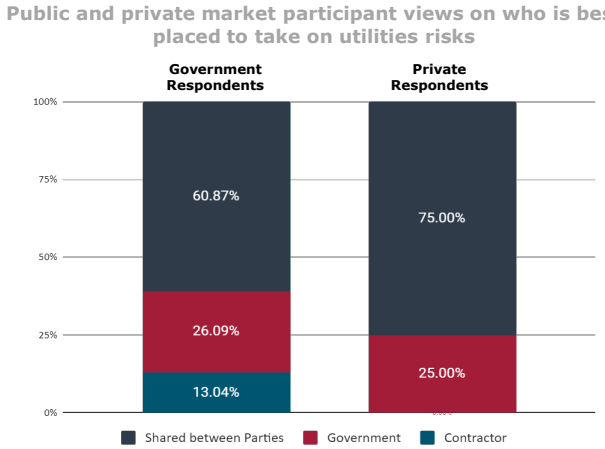


Figure 26: The figure shows who government and contractor respondents think is responsible for utilities.
Source: Infrastructure Australia 2021 Market Sounding Survey

Risk sharing - market sounding spotlight:
Significant divergence exist in who should bear utiliti risk. 75% of private sector believe it should be a shared risk compared with 61% of government and 13% of government respondents believing the Private e should solely take on this risk. A similar % on both sides believed government should take the lead for this risk.

Given the size and potential impact of this risk, steps will need to be taken in the future to seek to improve the level of understanding of utilities risk as well as a mature approach to sharing the risk.

Integration risk increases as new assets and technology merge with legacy systems

Impact Critical

Trend

Systems integration risk is the risk associated with commissioning and integrating a completed major project into the broader network or existing asset base.

This risk will become more prevalent given the scale and concurrency of the infrastructure pipeline, with significant brownfield projects meaning new infrastructure and technology are required to integrate into existing systems.

- On brownfield rail projects, integration risk is heightened by the introduction of high capacity train control systems, new rail stock, ticketing, and faster and additional rail services, for example.
- With renewable energy projects and small-scale generation, connection to the grid and integration that can unlock the benefits of distributed generation, will be needed.

The integration component of the project can often be overshadowed by the construction component, which is usually the largest portion of the project's cost. However, the more complicated piece can often be around systems integration, requiring early value engineering and a strong holistic delivery focus by the client.

Importantly, 22% of government respondents believed integration was the role of private sector partners, while 88% of private sector respondents felt the risks needed to be shared between parties.

Pipeline planning also has a role to play in mitigating integration risk. Where multiple projects are being delivered on related parts of a network, the sequencing of their design, specification, procurement and delivery is important.

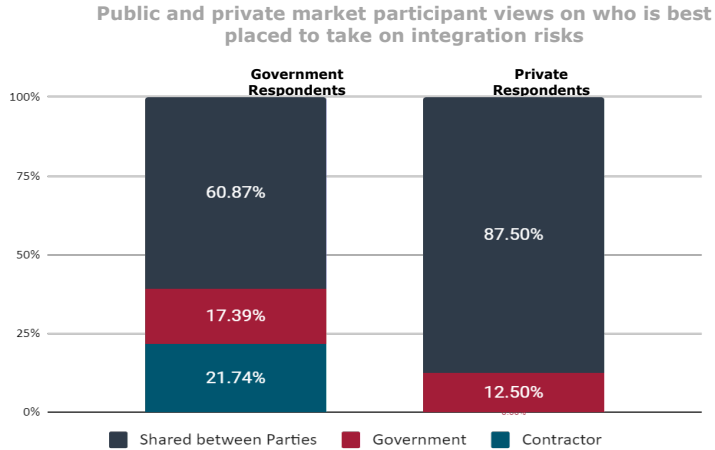


Figure 27: The figure shows who government and contractor respondents think is responsible for integration.
Source: Infrastructure Australia 2021 Market Sounding Survey

Market sounding spotlight:
Significant divergence exist in who should bear integration risk. 88% of private respondents believe it should be a shared risk compared with 61% of government respondents. 20% of government respondents believed contractors should be solely responsible for this risk

Case Study: Redcliffe Peninsula railway line
The Redcliffe Peninsula railway line was delayed for six months due to signalling system faults at Petrie where the new line joined the existing rail system. The project was delivered by the Department of Transport and Main Roads without the end user Queensland Rail (QR) being directly involved in the design and construction phase of the project.
Source: Cross river rail review

Unpredictable ground conditions is a common risk which can lead to significant impacts during project delivery

Impact High

Trend

Information from the market sounding and SMEs identified unpredictable ground conditions as a common challenge for all major projects, and in particular transport projects - especially those that involve tunnelling.

The risk arises because:

- It is often not possible to fully understand ground conditions ahead of the commencement of construction;
- Environmental challenges associated with groundwater and contamination, particularly in developed areas;
- The need to resolve issues relatively early in the construction phase (such that where unexpected issues arise they have a knock on effect across the project).

The extent to which unknown ground conditions are an issue is dependent on the specific geology of a region. For example, Melbourne's geology makes this issue particularly acute because its ground conditions are inconsistent. In these circumstances even the most comprehensive pre-construction sampling has the potential to miss features that could cause issues during delivery.

An issue for private sector tenderers is that they can be provided with extensive documentation during the tender phase which includes geotechnical reports and investigations on a 'no-reliance' basis. In these cases, firms would argue they should be entitled to rely on information provided to them during tender phase - and accordingly be provided with time and cost relief in the event the ground conditions turn out to be different than what the relevant reports concluded.

During consultations, some industry participants indicated they would be less willing to accept ground conditions risks moving forward. This means that effective management and collaboration between government clients and the private sector will be critical to effectively mitigate unknown ground conditions.

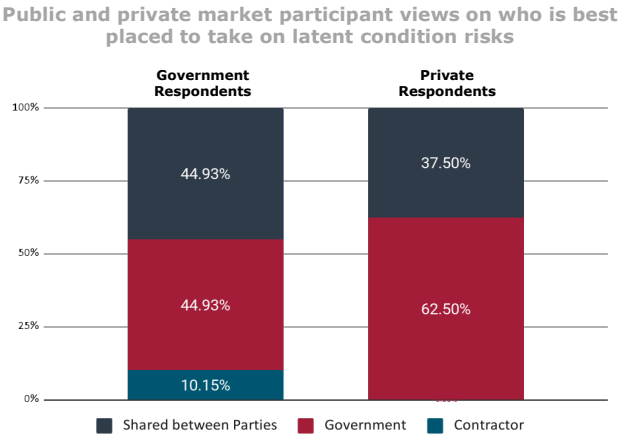


Figure 28: The figure shows who government and contractor respondents think is responsible for latent conditions.
Source: Infrastructure Australia 2021 Market Sounding Survey

Market sounding spotlight:
There is broad agreement between government and private sector executives in relation to ground (latent) conditions being shared (44% to 38% respectively), with 8% of government executives believing the private sector should bear this risk.

Interface risk is becoming more pronounced with the increasing size, scale and complexity of the infrastructure pipeline

Impact High

Trend

Interface risk arises where multiple projects (or packages of a single project) interact with one another or existing operations and maintenance during the design and construction phase. This risk is becoming more prevalent due to the volume and concurrency of major projects within close proximity or a brownfield location resulting in more complex interactions across projects and project stakeholders.

Some examples of key interface risks include traffic switching, design inconsistency, community messaging and temporary road connections. The risk manifests when stakeholders cannot reach agreement, or cannot effectively coordinate, resulting in project delays, cost overruns, legal disputes, and potential reputational harm.

Overly aggressive programs significantly amplify interface risk. Where there are issues on one project or package, the change of a consequential impact on interfacing works is minimised if there is time to remediate problems without altering the program for other works.

Packaging should deliver the simplest interfaces possible. Overly complex interfaces increase risk. Packages should be defined to ensure that interfaces are at points with the minimum technical and engineering complexity.

Public and private market participant views on who is best placed to take on interface risks

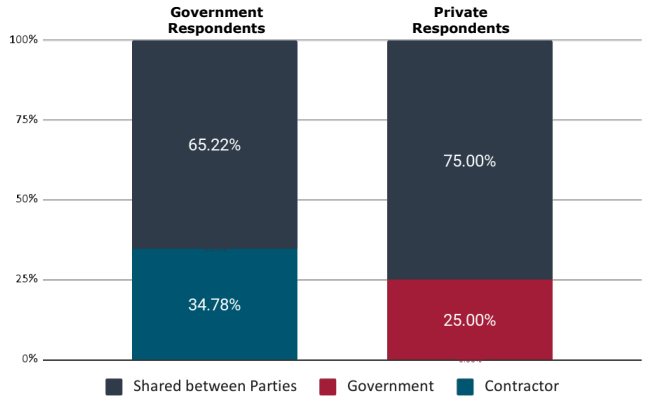


Figure 29: The figure shows who government and contractor respondents think is responsible for interface risks.
Source: Infrastructure Australia 2021 Market Sounding Survey

Case Study: Sydney Metro (stage 2) is a $15.5 billion rail line connecting the metropolitan rail network in Chatswood, through the CBD to the Southwest in Bankstown. The project was originally intended to be procured as a single PPP. However, in response to market feedback about the overall scale of the project and the difficulties associated with managing interfaces between different elements of the project, a decision was taken to disaggregate the packaging.

Market sounding spotlight:
Public and private sector respondents differed on who is best placed to bear interface risk, with a quarter of each indicating the *other* party was better placed. Nonetheless, the majority of respondents agreed that interface risk should be shared.

Capacity constraints in the insurance market have increased premiums and reduced coverage

Impact High

Trend

Changes to the availability and cost of insurance are having a significant impact on the delivery of infrastructure projects. This reflects global changes to the structure of the insurance market, as well as domestic factors such as the size and complexity of the infrastructure program, and growth in the number of claims for delay and other types of risk.

Industry participants informally estimated a 50% reduction in the capacity of insurance for the construction market as the costs continue to rise.

The impact is most pronounced with professional indemnity where there is challenge in understanding contractor requirements, with firms indicating the availability of professional indemnity insurance had dropped from $150-$200 million to around $50-$60 million, and that this could influence participation in bids.

Insurers confirmed there had been a wider shift towards more defined policies, and more niche insurance products in emerging areas such as cyber coverage.

Particular points of impact were observed:

- Contracting model impacts - traditional risk transfer procurement models (e.g. design and construct) have a higher exposure compared with an alliance model which shares the risk across parties;
- Asset type - a single site (e.g. a hospital) has more exposed risk in a single location as compared to a rail line where the risk is spread across the line. Renewable energy assets also have higher claims relative to other asset types particularly on solar panels;
- Social change - insurance for items like thermal coal is almost impossible.
- The insurance risk can be managed, but ultimately it results in transfer back to government.

Material reduction in the capacity for insuring construction

By 50% according to a leading insurer

3x

Cost increases in insurance over the last 2 years - Leading insurer

$200 on $5b

Maximum insurance on tunnelling projects for collapse - Tier one contractor

Section 5

Critical risks by infrastructure sector

Project risks vary by sector and asset type

Sectoral Risks: Assessment Overview

- This section provides a summary assessment of sector specific infrastructure risks, and assesses potential forward looking risks in the 0-5 year timeframe. Each sector is structured in three parts:
  1. Recent major project completions
  2. Recent risk performance, including Oxford Global Projects analysis on the sector
  3. Future projects pipeline and likely risk considerations
- Assessments were informed by a review of project registers, business cases, ANAO and Auditor General reports, the Dispute Resolution Board Foundation, Infrastructure Australia, and industry publications.
- In addition, analysis was commissioned from Oxford Business School, to benchmark Australian projects against global peers in relation to risk (cost and schedule) outcomes.
- In total, 234 historical projects which were completed in the last five years have been considered to validate risk identification and assessments, as well as market sounding interviews with executives from government, private, debt and equity providers and insurance companies.

Dispute resolution board - insights

Indigenous/European heritage site Inadequate heritage investigations leading to delays and cost overruns	**Road user frustration** Traffic detours, reduced speeds and longer commute times creating risk of fatigue and risk to future project being supported and approved	**Delay in planning approvals** Allocating planning approvals to contractor, who may not be sufficiently informed or equipped to resolve, leading to delays and cost overruns
Ground conditions Failure to assess ground conditions and plan for utilities movements, leading to delays and cost overruns	**Community impacts** Road construction impacting communities through noise, dust and visual impacts leading to increase costs and project delays	**Wet weather provisions** Insufficient provisions within contracts around wet weather days leading to project delays
Handover issues Mis-match in expectations between the Principal and the Contractor as to how the handover requirements would be administered.	**Hydro approval conditions** Departure of the final conditions of approval from the estimated conditions, led to significant cost increase	**Reference design change** Late understanding of inadequacy of the reference design, exposed contractor to risk

Australian Government | Infrastructure Australia

Assessment overview

TRANSPORT PROJECT RISKS	0-5 year assessment	
	Rating	Trend

There are 215 major transport projects in the pipeline, representing 58% of pipeline projects in Australia. Over the next 5 years, the Australian market will also be delivering an unprecedented program of rail development, including Inland Rail, Cross River Rail, METRONET, Suburban Rail Loop, NE Link, Melbourne Metro, Gold Coast Light Rail S3,and Sydney Metro.2 Critical risks for this sector include:

Increasing prevalence of social license issues as network disruption from multiple concurrent projects heightens impacts in urban areas.	High	↑
Greater attention required to cost and scope environmental and land contamination, which may result in costs and delays.	High	↑
Increasing prevalence of tunnelling in projects will require greater specialist capability nationally, to manage increasing risks on ground movements as well as geotechnical issues.	Critical	↑
Land acquisition challenges will result in increased project costs due to underestimated compensation costs to landowners, and/or late changes affecting project scope and design	Critical	↑
Project based rather than network approach, resulting in re-work and benefits underachievement.	High	↑

Sector	SOCIAL INFRASTRUCTURE PROJECT RISKS	0-5 year assessment	
		Rating	Trend

In the next five years, social infrastructure comprises 15% of the project pipeline, with 25 hospital projects under planning, or $17 billion of investment, and new justice, entertainment, social housing, and education infrastructure. Critical risks for this sector include:

Social	**Business cases for social infrastructure are frequently without adequate Operations and Maintenance funding** resulting in significant un-scoped financial burden for governments.	Critical	↑
	Business case guidelines favour economic infrastructure projects compared to social projects.	High	↑
	Demand shifts and population growth may result in school infrastructure becoming redundant well within the asset life.	Medium	↑
	Over-reliance on health professionals rather than care models is resulting in infrastructure not meeting needs.	High	↑

Transport and social infrastructure projects comprise 73% of the pipeline, with ground conditions and urban environments driving complexity…

Water and energy sector transition is driven by climate change, where uncertainty is impacting on long term investment and deliverability

ENERGY PROJECT RISKS	0-5 year assessment	
	Rating	Trend
The Clean Energy Council notes there are 98 projects in construction or due to commence soon, representing 10,395 MW and $19B in investment, including Yandin Wind Farm, Sunraysia Solar Farm, Sun Cable, Snowy Hydro and the Vic Big Battery Project.3 Looking ahead, the critical risks for these projects include:		
Complex projects like hydroelectric dams are at risk of cost overrun.	High	↑
Underlying connection and transmission infrastructure to support renewable energy is underdeveloped, creating potential for low grid resilience and 'orphan infrastructure' unable to connect into the network.	Critical	↑
Lack of policy coordination is disbursing investment focus, leading to lower investment effectiveness and less efficient investment parameters.	Critical	↑
Consumer preference is changing type of energy demanded, with consumers preferring energy produced through renewables.	Medium	↑

WATER PROJECT RISKS	0-5 year assessment	
	Rating	Trend
The next five years will see significant water infrastructure development with 15 major projects including dam and water treatment infrastructure. Upcoming projects include Warragamba Dam Raising, South Creek, Prospect to Macarthur Link. Critical risks for this sector include:		
Complex governance issues with dispersed authority creates decision uncertainty for delivering the infrastructure pipeline.	High	↑
Inability to access skilled migrants increases competition for talent, with cost of labour expected to rise while the quality of labour reducing.	High	↑
Lack of national policy framework creates uncertainty for investment.	Critical	↑

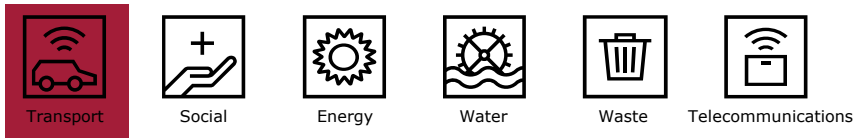
In waste and digital infrastructure, ambitious national policy objectives create a situation where inadequate planning and market incentives are critical risks

WASTE PROJECT RISKS	0-5 year assessment	
	Rating	Trend
There is a pipeline of around $2 billion in waste infrastructure in Australia, and significant growth is likely as the market adjusts to the waste export ban. Projects are planned and under development, including Swanbank, Australian Paper Energy from Waste Facility, and Parkes Recovery and Energy from Waste Facility. Critical risks for this sector include:		
Inadequate infrastructure development coordination for all stages of the waste cycle, from collection to aggregation to treatment, will cause cost overruns and benefits underruns.	Critical	↑
Ineffective community engagement continues to lead to social license problems causing project delays and increased costs.	Critical	↑
Security and scale of supply of feed stocks for waste to energy projects.	Medium	↓
Low levels of market and regulatory readiness.	High	↑

TELECOMMUNICATIONS AND DIGITAL PROJECT RISKS	0-5 year assessment	
	Rating	Trend
NBN Co made a recent commitment to deliver the next 'targeted' phase of investment and network improvement by 2023. A program of $4.5 billion will deliver improved wholesale speeds for 75 % of homes and businesses in the fixed-line footprint, invest in initiatives with retail internet providers, and support state and territory partnerships in regional and remote Australia. This will occur alongside state government 'Gigabit program' initiatives and private sector investment in 5G and mobile connectivity. Critical risks for this sector include:		
Underinvestment in network improvements.	High	↑
Lack of market incentives for regional and remote access.	High	↑
Declining returns on private investment and 'free rider' issues for 5G investment	Medium	↓
Poor understanding of existing utility infrastructure, leading to scope growth and cost overruns.	Critical	↑

Section 5.2

Transport risks



Recently completed projects highlighted the importance of early planning for ground conditions, and the emergence of collaborative contracting

The Australian market has successfully delivered a growing number of major transport projects in recent years, with Australian transport projects out-performing comparator projects overseas on cost and schedule outcomes.

Nonetheless, recent project completions and procurement processes such as WestConnex Stage 2, NorthConnex Twin Tunnel and West Gate Tunnel, highlight the ever-present concern of ground conditions.

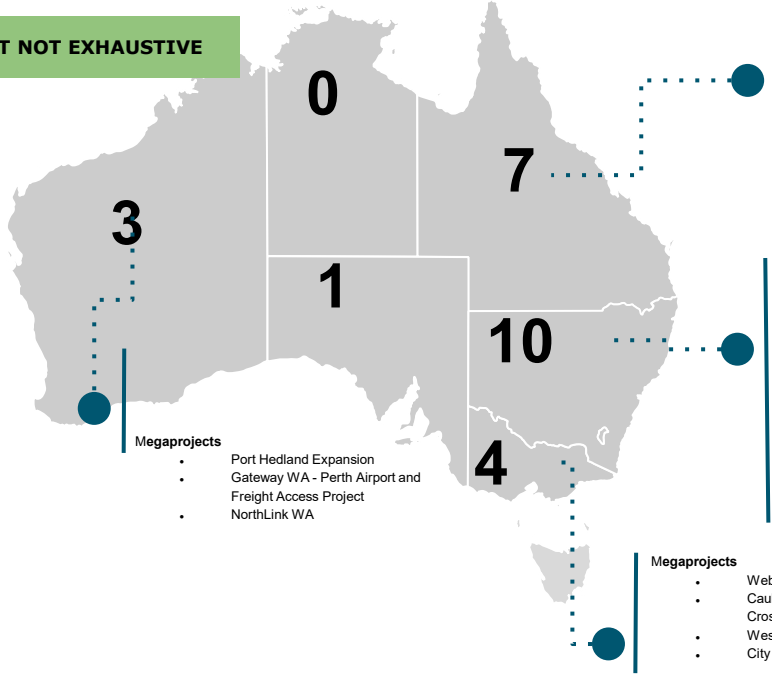
Industry participants consulted for this report argued strongly that while they are well placed to manage these risks when found, the ground conditions over long corridors are 'unknowable' and 'unpriceable' before construction.

Analysis identified the following 5 critical risks:

1. A shortage in the specialised workforce within the transport industry, could delay projects resulting in schedule and cost impacts.
2. Land acquisition challenges can lead to sub-optimal design, extended project schedules, and higher costs.
3. Inadequate scoping of utilities can lead to utility disruptions, schedule and cost overruns, and design changes.
4. Unexpected geotechnical conditions can impact project milestones and increase project costs and schedules.
5. Ongoing COVID-19 recovery could limit construction work and delay projects.

Recent completions

LIST NOT EXHAUSTIVE



Complex transport projects have steeper cost uplifts, but small road projects can overrun by more than large road projects

Small vs large road projects (global dataset)

- On average large road projects were not more prone to cost overrun than smaller ones, with both having an average 30% cost overrun.
- However projects under $350m displayed a tendency to have larger cost overruns, with the median cost overrun of smaller projects being 50% greater than the median cost overrun of large projects (21% vs 14%).
- Large projects tended to have greater cost overruns towards the extremes of the distribution.

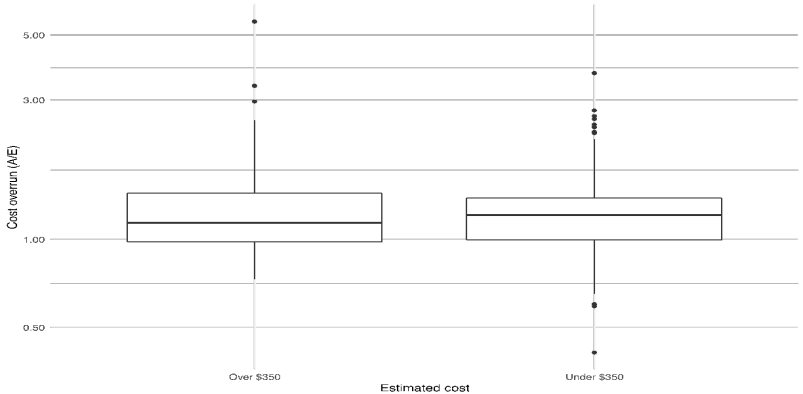


Figure 30: Cost overruns for transport projects above and below $350m. Global dataset, including Australian data and statistically similar to Australia

Source: Oxford Global Projects, 2021

Asset type comparison (global dataset)

- Globally, 75% of road projects were delivered over budget, with motorways and non-motorways being relatively similar in expected cost overruns. The worst performing 5% of road projects had disproportionately large cost blowouts.
- Urban and high speed rail had the greatest tendency to go over budget, with 80% of all project costing more than expected, while half of projects costed at least 30% more than budgeted.
- Conventional rail had the least cost variance, with half of the projects having a cost overrun of 10% or less (one quarter of projects also came out under budget), while fixed linked projects which went over budget tended to do so

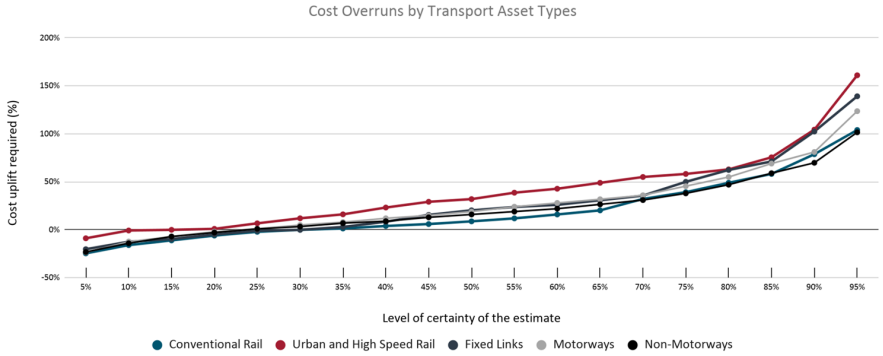


Figure 31: Cost uplift required for transport projects by asset type. Global dataset, including Australian data and statistically similar to Australia

Source: Oxford Global Projects, 2021

Schedule overruns vary by transport asset type

Small vs large projects (global dataset)

Transport projects with an initial budget of less than $350m had statistically more significant schedule overruns than larger projects, with the median small project having a 50% schedule overrun compared to larger projects being roughly on time.

Smaller projects tended to have a much larger range of schedule outcomes, both under and over schedule, with 25% of smaller projects taking over twice as long to complete than initially planned.

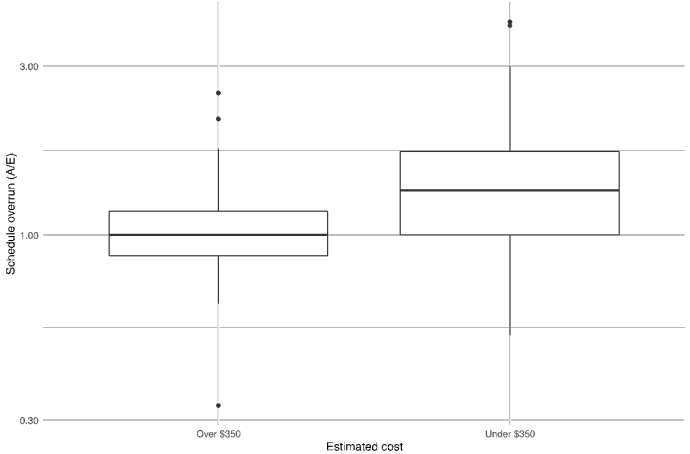


Figure 32: Schedule overruns for transport projects above and below $350m. Global dataset, including Australian data and statistically similar to Australia

Source: Oxford Global Projects, 2021

Asset type comparison (global dataset)

Globally, fixed link rail projects had less severe schedule overruns than other rail projects, with 25% of fixed line rail projects exceeding a 35% schedule overrun (vs 40% of non fixed link rail projects having a similar overrun).

Half of fixed link rail projects were within a 5% overrun of the scheduled delivery time, while only 35% of other other rail projects delivered on time or earlier.

On average road projects were completed on time relative the schedule estimates in their final business cases, with roughly half being finished earlier than expected while the other half finished later than expected. For projects which did exceed the expected timeline, half of those went over it by less than 10%, and three quarters of them went over by less than 20%

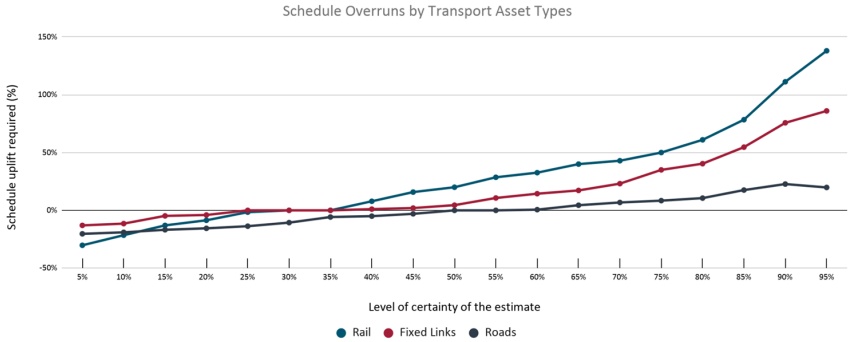


Figure 33: Schedule uplift required for transport projects by asset type. Global dataset, including Australian data and statistically similar to Australia

Source: Oxford Global Projects, 2021

The forward looking pipeline of transport projects will potentially be exposed to recent technical, in-ground risks, as well as integration and interface issues

The forward pipeline for transport is significant and comprises the majority of projects in the national infrastructure pipeline.

There has been a major increase in the number of megaprojects in the future pipeline, including metro development, transcontinental freight corridor development, and major rail and road upgrades.[2]

The large program of major urban projects suggests that contamination, in-ground and utilities risks, community opposition and interface risks, are likely to be amplified in the next 5 years, with more complex tunnelling projects and connections to existing networks in planning.

While the COVID-19 pandemic continues in 2021, it is unlikely to be a major risk factor in future. Further detail on Transport related risks are detailed later in this section.

58% of the future pipeline is Transport

Future pipeline

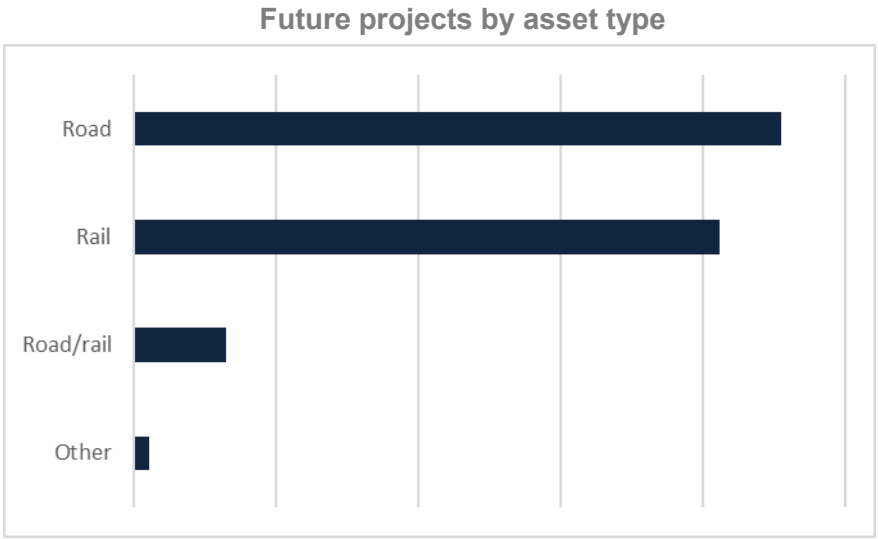


Figure 34: Projected $ proportions of future transport project by asset type, next 5 years.

The next tranche of transport projects will continue to be exposed to risks associated with urban disruption, land contamination and tunnelling risks

Business and community disruption

- Social licence issues arise where urban project delivery conflicts with existing economic and social uses. Over the past 10 years, community opposition resulted in $20 billion in infrastructure delays and cancellations.[30]
- The recent Sydney Light Rail project led to $31 million of compensation to small businesses due to light rail construction delays, and significant community opposition to the corridor development.[42]
- In Victoria, 10 small businesses have to date closed as a result of its level crossings programs.

Impact High

Trend ↑

Contamination and cost to remediate

- Contaminated land can have a **high** impact on planning delays, with OHS and additional approval processes required affecting the budget and timeline of the project.
- Uncertainty around the level and volume of contamination risk in urban areas is an extreme risk to new infrastructure projects, specifically asbestos, PFAS and alkaline soils. Uncertainty around the quantity of contaminated materials manifests in time delays and the costly remediation pose a risk to budget blowouts.
- **West Gate case study:** The discovery of harmful contaminants in the soil resulted in lengthy disputes between private and the government, delaying the project by at least 12 months, and led to both cost overruns and laid-off workers due to work on the project being halted while the contaminated soil was removed.
- The estimated cost of all remediation works for contamination for the M4 widening was $200m in Western Sydney, from a total project cost of ~$500m.

Impact High

Trend ↑

Tunnelling and ground movement risks

- There will be a 25% increase in the number of tunnels in Australia's major cities over the next 5 years.[2]
- An emerging risk in Australia associated with tunnelling relates to ground movements both during and after construction.
- Limitations in geological surveys to accurately determine the exact geological conditions under the ground is a large challenge to tunnelling. The uncertainty of ground conditions leads to project delays as engineers revise technical plans. A major aspect of the $2 billion cost blow out of the Melbourne Metro was attributed to encountering an unexpected soil density, resulting in digging delays.[44]
- For the contractor to satisfy itself as to the character and quality of the subsurface materials, they will be required to perform additional site investigation after award of the contract.
- Whilst these risks will almost certainly pose an critical impact on tunnelling projects, the overall impact to the transport projects is possibly posing a moderate impact.

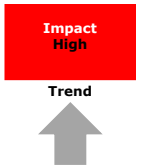
Impact Critical

Trend ↑

Transport projects will continue to encounter network integration and land acquisition risks

Network integration planning is often delayed resulting in costly rebuilds of infrastructure

- Across the Transport sector there is a risk associated with the development of individual projects without properly planning for current and future network integrations.
- This risk can manifest in the shifting of capacity bottlenecks to alternative locations on the transport network, or in terms of technology interface issues, such as a new signalling system being incompatible with an operational system.
- Taking a broader corridor or network approach to transport infrastructure planning ensures that project benefits are maxmised for the network as a whole and enabling reforms or projects are in place.
- These risks can be driven by heavy focus during the planning and business case phase on the project and avoiding key legacy costs issues to improve the BCR and viability of the project.
- There is also a capability challenge in the tools, skills and expertise to plan and think about a network/corridor approach to infrastructure as well as the supporting processes, including investment.

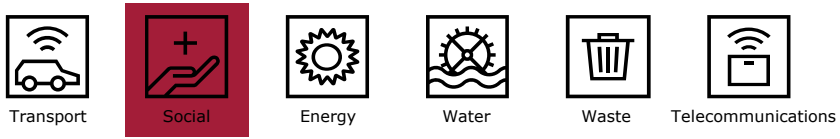


Poor land acquisition assessments and processes are resulting in higher project costs

- Failure to carry out the usual enquiries for assessing market value, producing a "restricted assessment" with a lower level of assassurance leads to inability to capture benefits and overvaluation of land.
- This risk is particularly prominent in linear infrastructure, such as transport projects, where large tracts of land need to be purchased for the projects often with significant contamination issues.
- This has led to overcompensation of land for the Western Sydney Airport as identified by the ANAO.
- The Parramatta Light Rail project announcement lead to the price of land in Camellia increasing sharply, for which the government paid three items the estimated price of land. Further, according to 2015 contamination study, Camellia had "high likelihood of significant soil and groundwater contamination", including carcinogenic chemicals which could add additional remediation costs of up to $200m.[46]

Section 5.3

Social infrastructure risks



Recent social infrastructure projects have had risks manifest in relation to future operating requirements not being correctly considered

Social infrastructure projects can break the traditional nexus between project size and project complexity. Sector experts noted that hospital and prison projects for example - large or small - have 'trickier' risk profiles, with complex stakeholder issues, design risk and uncertainty over future operating requirements from policy and technology change.

Wider concerns about contractor experience in a tight infrastructure market were observed as well as ground condition risks. Social infrastructure project risk tends to heighten nearer the point of commissioning.

Analysis of recent major projects identified the following high risks:

1. Inadequate site due diligence leading to remediation or enabling works.
2. Failure to design for emerging technologies can impacts future operations of infrastructure like hospitals.
3. Not considering operational costs in the design phase can lead to higher costs and impact future operations.
4. Inaccurate expectations of land acquisition costs and timelines can delay projects
5. Inadequate scoping of main line services around a site can lead to accidental disruptions.

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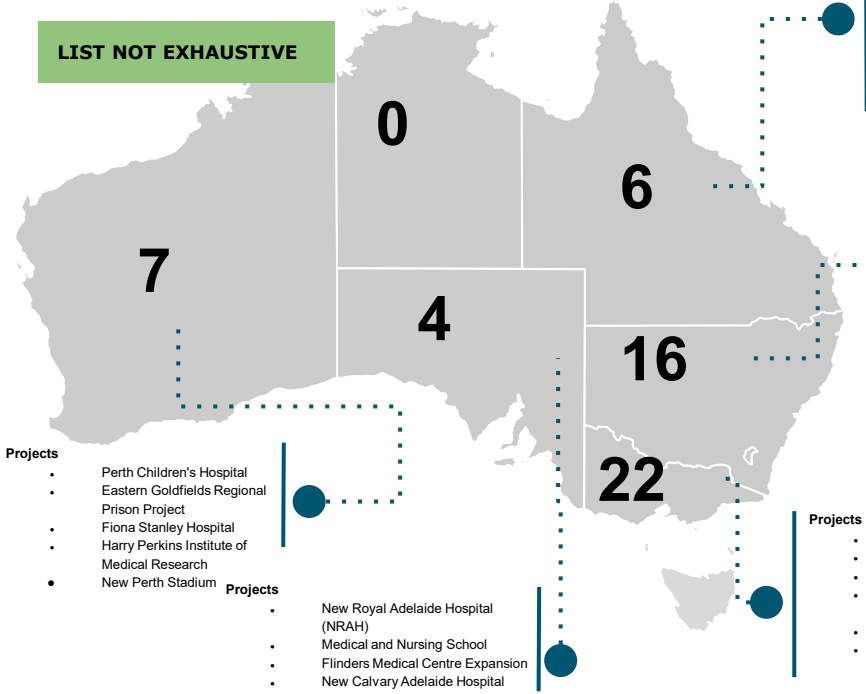
Recent completions



The future social pipeline has significant hospital projects requiring strong operations planning

Roughly two-thirds of Australia's social infrastructure pipeline will comprise new health infrastructure and upgrades to existing health facilities.[2]

The events of COVID-19 have highlighted a need to ensure health infrastructure is adequate to support a growing population and increased risk to pandemics.

Social infrastructure is a major part of the national infrastructure pipeline, with the majority of those projects being hospital redevelopments or new builds.[2]

Risk registers, reports and extensive SME discussions highlighted the following risks to the future pipeline:

- Funding - too much capital expenditure spending and too little operational funding to support.
- Risk that social infrastructure benefits, and consequently infrastructure projects, are heavily demand driven. This causes the risk that shifts in population trends may result in early benefit underruns

Those risks are further outlined in the following pages, excluding materials which is explored in the project risk section of this report.

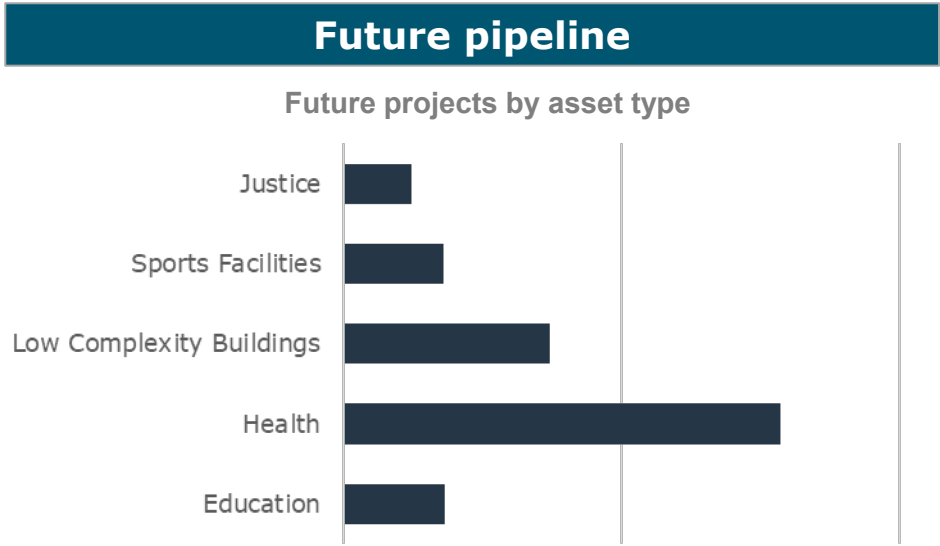


Figure 35: Projected $ proportions of future social infrastructure projects by asset type, next 5 years.

Over $17b in hospital infrastructure

Funding and operational models are not being appropriately accounted for in selection and design, causing greater operational risks

Unfunded operations for new infrastructure

Impact: Critical

Trend: ↑

- The cost to service social infrastructure outweighs the cost of the infrastructure itself. Unlike transport, for example, where project construction represents over three-quarters of the cost, social infrastructure can see delays at commissioning, or suboptimal use, if service and infrastructure planning are not aligned.
- Over the decade 2007-09 to 2017-18 New South Wales, Queensland, Western Australia, Tasmania, Northern Territory and the ACT recorded average annual per-person funding growth of just 1-2% despite hospitalisations growing by 3.3% per year on average.[54] Ultimately this has seen benefit underruns in increased patient waiting times and bed shortages, despite growth in infrastructure spending.[54,55]
- With the new 2020-25 public hospital funding agreement to be delivered with the same funding formula, it is almost certain new hospital infrastructure will encounter this risk and will continue to pose an extreme impact on the realisation of benefits.
- This issue can be avoided, although market proponents have agreed this requires a fundamental change in the funding structure.

"In 2020-21, the Commonwealth share of public hospital funding will be indexed by just 2.1% – a rate that is too low to accommodate for growth in service volume." - Australian Medical Association.[55]

Social infrastructure projects and benefits quantification

Impact: High

Trend: ↑

- Market proponents have identified unique challenges in submitting successful business cases to obtaining approval for social infrastructure, particularly acute facilities. due to difficulties in quantifying the intangible benefits of social infrastructure initiatives.
- This could in part explain why there are relatively few social infrastructure projects compared to other demand driven developments such as infrastructure in the transport sector.
- This will have a major impact on those projects still in pre-approval stages, specifically posing a risk to their likelihood of going ahead.
- Proponents suggested that business case guidelines favour economic infrastructure projects compared to social projects and this would need to change to help reduce this risk.

Demand shifts and population growth results in low asset utilisation

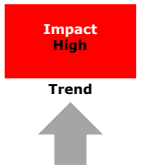
Impact: Medium

Trend: ↑

- Social infrastructure is unique in that its benefit is directly correlated to its use by people in neighbouring communities.
- Whilst it is possible to predict national or city level population growth, it is difficult to predict changing demographics of suburbs.
- The uncertain nature of community demographics increase the risk of benefit underruns in social infrastructure developments.
- A market proponent highlighted this issue in school infrastructure, where sudden migrations into a suburb force schools to expand (either through land acquisition or vertical expansion), only to see demand decline in 6-10 years as students pass out of school.
- The proponent suggested the need for flexible infrastructure to cater to unpredictable shifts in demand, with one solution being temporary school buildings.

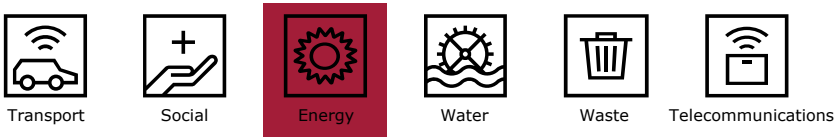
Complex stakeholder environments make it difficult for new projects to pioneer future models of care

- There is a growing risk associated with the development of new hospitals relating to the balance of input from clinical staff vs the design and build of infrastructure being driven by the model of care required.
- Traditionally the approach has taken a strong stakeholder input into the development of social infrastructure, particularly hospitals, however evidence from expert discussions, indicate that the often views do not properly consider and take into account future care models, resulting in a mismatch between the physical build and how services will need to run in the future.
- The impact of this is high, with infrastructure being built that may not properly support the operational requirements of the future hospital given the lack of alignment to new care models being introduced. This can lead to re-development costs of the hospital over time.
- This can be mitigated through the careful consideration of the model for design for new hospital infrastructure to ensure it focussed on future care models.



Section 5.4

Energy risks



85% of recent energy projects were wind and solar with infrastructure investments impacted by policy uncertainty

The energy investment pipeline is growing significantly, with significant wind, solar and energy storage developments in the five years to 2020.

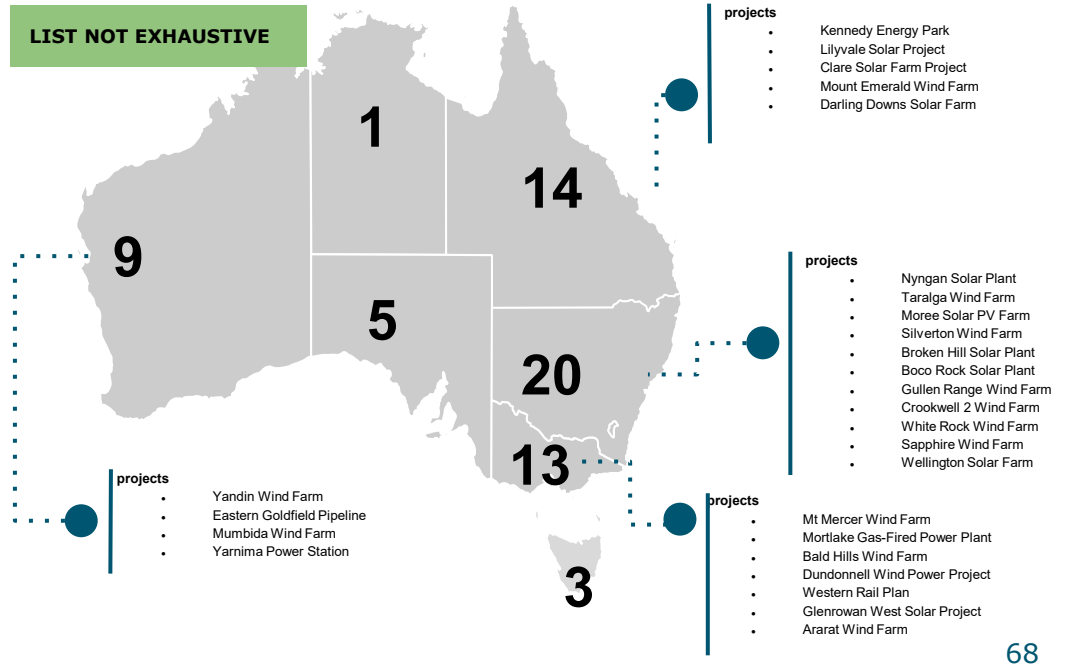
These assets have been impacted by policy uncertainty, which has impacted pricing and value, the timing of grid connection, and on some projects, completion risk.

The recent failure of major contractors including RCR Tomlinson, Todae Solar, and R&L Solar, is seen by market observers as an indication of new risks not being properly understood or managed, while the consolidation of solar portfolios is viewed as an indication of policy and pricing uncertainty.

The analysis of recent projects identified the following four high risks:

1. Equipment and labour shortages due to the large pipeline, particularly at the higher levels such as project managers.
2. Global supply chain disruptions (amplified by COVID) leading to project delays and cost increases.
3. Underdeveloped transmission and distribution infrastructure is creating physical network congestion, constraints and delays to project completion.
4. Supplier insolvency and procurement issues can delay projects and limit supply of key materials.

Recent completions



The Oxford Global Projects database indicates that larger and more complex energy projects are at higher risk of cost overruns

Small vs large projects

Larger energy projects had twice as large cost overruns on average as compared to smaller projects (32% vs 74%)
Similarly the median cost overrun was 50% greater for larger projects, highlighting the fact that larger energy projects have a tendency to have proportionally much larger cost overruns as compared to smaller ones.

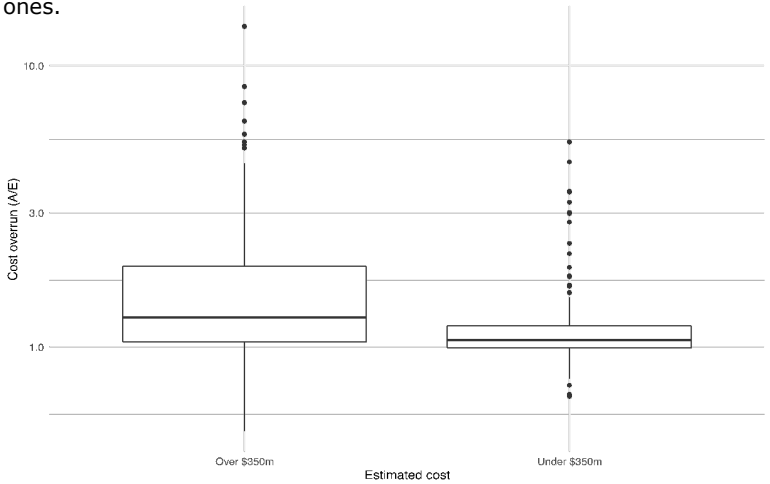


Figure 36: Cost overruns for energy projects above and below $350m.
Source: Oxford Global Projects, 2021

Asset type comparison

The median cost increase for projects across the global energy infrastructure space (excluding transmission line projects) were 25% for hydro, 7% for thermal, and 5% for wind. Only roughly 40% of solar projects went over budget, while only 10% of solar projects had cost overruns which exceeded 16% of the initial cost.

Solar and thermal projects had a greater tendency to be under budget, with 25% of solar projects and 40% of thermal projects cheaper to deliver than originally costed.

Globally, half of hydro projects are more than 25% over budget, while one quarter of hydro projects cost over 75% more than their budgeted construction costs. Solar and wind projects tend to have the lowest variance in costs relative to their initial budget.

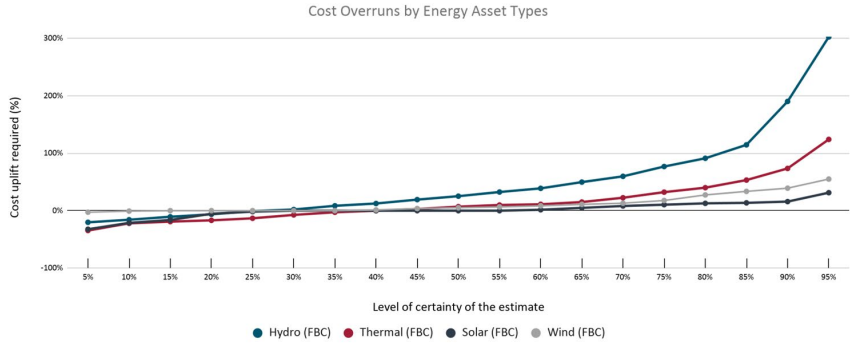


Figure 37: Cost uplift required for energy projects by asset type.
Source: Oxford Global Projects, 2021
FBC = Final Business Case

The Oxford Global Projects database indicates the majority of energy assets are delivered later than expected

Small vs large projects

Globally, larger projects (>$350m) tended to have proportionally slightly larger schedule overruns as compared to smaller projects, however the difference was not statistically significant

However, when comparing projects with an initial cost of $1b or more to those costing less, there was a significant difference in schedule overruns, with larger projects being more likely to have schedule overruns, and having proportionally much larger overruns when they did occur

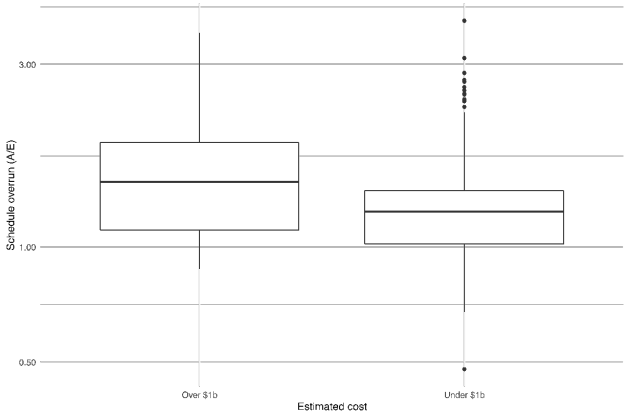


Figure 38: Schedule overruns for energy projects above and below $350m.
Source: Oxford Global Projects, 2021

Asset type comparison

Globally, solar projects were the most likely to meet the expected construction timeframe. Three out of four solar projects were delivered on time and nearly half were delivered earlier than expected, while 95% of solar projects were delivered with less than a 15% schedule overrun. In contrast roughly 65% of wind projects and 75% of hydro and thermal energy projects were delivered later than expected.

Globally, hydro projects were the most likely to run over schedule with an average schedule overrun of 33%. Less than 25% of them met the expected delivery date, while ¼ of hydro projects went at least 50% over the expected construction timeframe.

Solar and wind projects tended to have the least cost variance and limited cost blowouts, while hydroelectric dams had a strong tendency to run over budget.

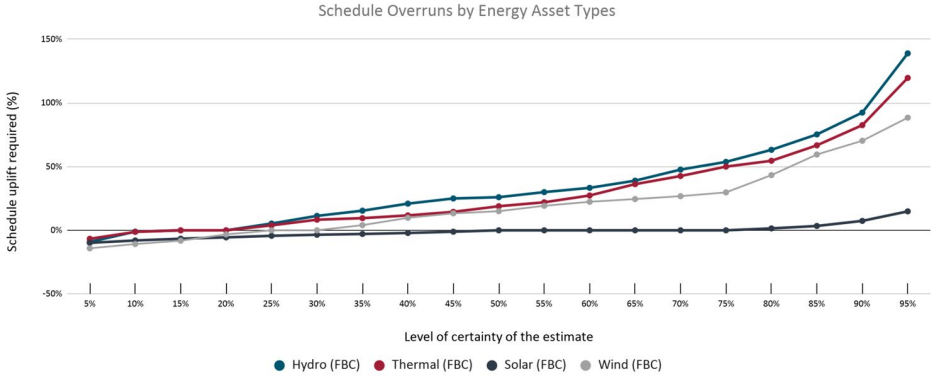


Figure 39: Schedule uplift required for energy projects by asset type.
Source: Oxford Global Projects, 2021

FBC=Final Business Case

There is significant growth in the energy pipeline with materials, policy uncertainty and consumer preferences shaping success

Due to technology enhancements and continuing build-out of a renewable energy target, Australia has seen a substantial increase in renewable projects in the future pipeline across solar, wind, hydro and the emerging arrival of (green) hydrogen.

Add to this the significant shift globally to Envrionmental, Social and Governance (ESG) outcomes with lenders and equity investors indicating during market soundings that future investments will have to comply with clear ESG requirements and published trajectories.

Energy represents a significant portion of the national infrastructure pipeline, and has had a large increase in projects relative to previous years. Large-scale renewable hubs, which are a combination of 'green' energy sources, will form the majority of energy projects over the next five years.[2]

The prioritised risks impacting the future pipeline are outlined further in this section.

20% of the priority pipeline is energy.

Future pipeline

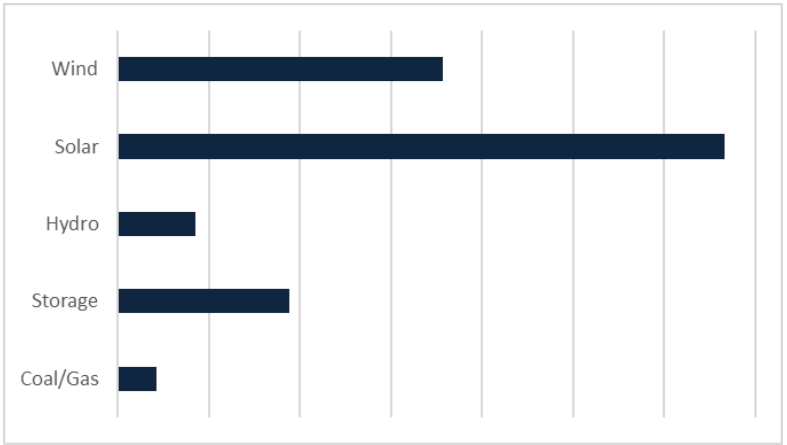


Figure 40: Projected $ proportions of future energy projects by asset type, next 5 years

Next generation energy infrastructure, policy uncertainty and funding drive the high risks in energy infrastructure

Policy coordination could encourage investment

- There has been concerns about the absence of a long-term policy setting, which provides limited incentives to invest into large scale renewable energy project at a national level.
- Instead, multiple states have set state level renewable energy generation targets.[51]
- Although a minor impact to the pipeline, it is worth noting that short election cycles and green energy used as a political argument between major parties leads to changes in energy policy over time. For example, a planned new national energy policy, the National Energy Guarantee, was abandoned in 2019 under the current government's regime.
- Policy announcements when made often include little detail, creating great uncertainty around investment - for example, the Underwriting New Generation Investments program.
- As a result, a lack of consistent direction in the transition of Australia's electrical grid to renewables has created investment risks, and reduced renewable energy investment, as investors sacrifice low maturity renewables energy projects in favour of projects that provide greater certainty on cash flows and investment return.

Underdeveloped grid infrastructure

- Investment in renewable energy assets has declined from its peak in 2017-18. The Clean Energy Council announced investment of $600m in large-scale renewable projects in Q2 2020, which represents a drop of almost half from the previous quarter.
- At the same time, significant additional investment will be required to achieve the goal of 90% electricity provision by 2035.[49]
- A significant and growing challenge limiting investment is achieving connection to the grid. Market proponents from Northern Australia have noted this is particularly challenging in remote areas, which has created uncertainty for renewable energy developers through significant delays in connecting to the grid.
- Similar issues are being experienced in other regions across Australia, including South West NSW and North West VIC - due to significant volumes of renewable projects attempting to connect to weak grid infrastructure.
- In response to these challenges, policy and regulatory changes imposing output constraints, marginal loss factor reductions and the imposition of additional technical requirements on new generators has had further impact on the attractiveness of new renewable energy investment and general confidence in the sector.

Complex projects have significantly higher risk of cost overrun

Impact High

Trend

- The next generation of energy infrastructure relies on wind, solar, hydroelectric and storage assets such as batteries. Whilst renewable energy now generates 63 TWh annually, the industry is still relatively early stage and will require further development overtime to facilitate ongoing growth.[47]
- To support this growth, new and augmented transmission and distribution lines, systems and interconnectors need to be built to support further renewable build out.
- Network projects are large complex, highly-regulated ventures which by nature affect kilometres of land area and communities and generally take 5-10 years from concept to completion. They are at great risk of cost overrun, with network costs ultimately borne by consumers.
- Consistent with history, hydroelectric systems are also at great risk of cost overrun, due to greater development lead time and high upfront costs with engineering and construction.[48]

Consumer preference is changing type of energy demanded

Impact Medium

Trend

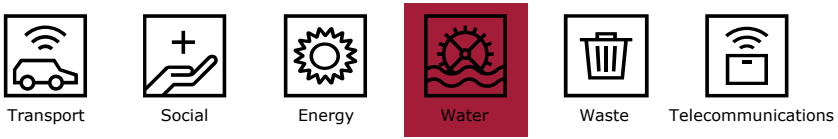
- Consumers prefer energy produced through renewables, and can opt for these in their energy plans. Current renewable investment is not enough to meet this, with renewables contributing to only 27.7% of total annual electricity generation in Australia.[52]
- We have seen an exponential increase in the installed capacity of small scale solar systems that generate up to 100KW, with roughly 3200 megawatts installed annually in 2020.[53]
- Growing use of residential batteries and solar is creating greater demand for localised industrial battery capability. More batteries will be needed to stabilise energy supply on the grid.
- Consumer preferences are also influenced by ESG considerations. While debt and equity providers have all agreed that there is an abundance of capital available, fund managers have stated ESG has become a key driver in investment decisions, including decisions to not invest in coal and other fossil fuel projects.
- ESG has come a long way over the last decade, with new emission regulations pushing companies to not just think about their emissions, but rather to show how they have strived for carbon neutrality.

Case study - Sunraysia Solar Farm

- Sunraysia Solar Farm is located in South West NSW
- After achieving financial close in 2017 and with commercial operations anticipated in 2019, Sunraysia is still yet to finish the commissioning process. This delay has resulted in significant losses to Project owners John Laing and Maoneng, and has contributed to John Laing's decision to exit the Australian renewables market
- This delay is primarily a result of limited grid infrastructure contributing to significant curtailment to project output and a reduction of MLF (reducing project revenues by 20%)
- Delays to commissioning have also contributed to a dispute with the project's contractor Decmil, resulting in extensive legal costs. Similar issues around liability for delays have contributed to the insolvency of contractor RCR Tomlinson, and Downer's exit of the Australian solar market

Section 5.5

Water risks



Recently completed project saw planning delays and lack of a national water strategy impact on efficient infrastructure delivery

The delivery of traditional water projects carries mature and known risks. Recent projects include Urannah dam, Lower Fitzroy, and Pilbara Coastal Water Project.

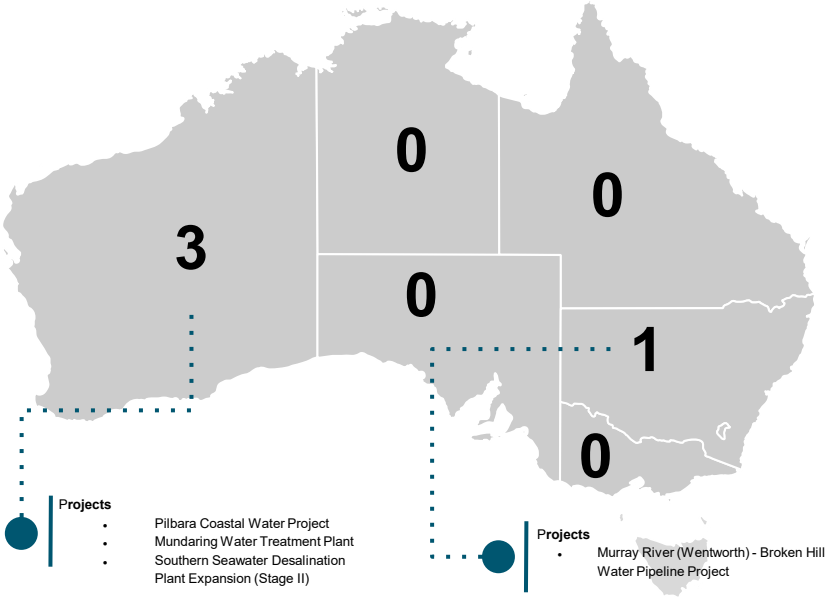
Nonetheless, emerging technology in water and waste treatment that support a shift towards sustainable and circular infrastructure, have introduced complexities to projects during option selection and commissioning.

In addition, major water projects have seen planning delays and planning uncertainty with recent climate variability.

The analysis of risks in the water sector identified five risks, outlined below:

1. A lack of coordinated water strategy between states and territories and the Australian Government can impact approval times.
2. Lack of early stakeholder and community engagement can delay projects due to planning approval processes, and community acceptance.
3. Lack of sufficient compensation of landowners can lead to legal challenges.
4. Inexperienced project managers and skilled workers for specialised infrastructure such as dams can delay projects.
5. Lack of private funding to develop desired infrastructure.

Recent completions



The forward pipeline will have greater exposure to labour shortages and continue to be challenged by complex governance

In the future, as climate change continues to cause significant change to rainfall patterns, distribution and intensity, the planning of water infrastructure will need to shift away from traditional climate dependent infrastructure (eg dams) to climate independent assets (eg desalination).

Currently, the forward pipeline of water infrastructure projects represents a relatively small portion of the total infrastructure pipeline. However, the majority of these comprises dam-related projects.

This significant change carries transition risks.

- Emerging technology in water and waste treatment that support a shift towards sustainable and circular infrastructure introduce complexity during option selection and commissioning.
- More distributed models of water capture and supply require a significant shift in the way water is managed, similar to the shifts that are underway in the energy sector.
- There are also shifts associated with evolving economic needs to meet the demands of existing agriculture and mining industries, as well as emerging industries such as hydrogen production.

The following slides provide further detail on future project risks.

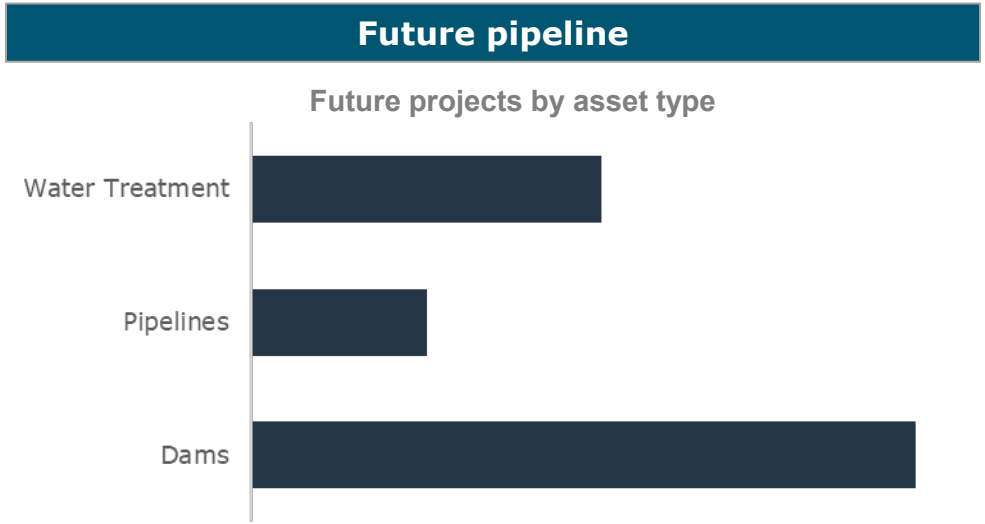


Figure 41: Projected $ proportions of future water projects by asset type, next 5 years.

56% of water projects in the pipeline are dam related.

Insufficient supply of skilled construction professionals and the absence of a national framework for water are increasing risks in the sector

Complex governance

- There is an increasingly complicated and influential governance arrangement for water across the jurisdictions resulting in delays and sometimes cancellation of projects.
- This has most recently been seen within regional water infrastructure and the program of work around new or improved dam infrastructure across NSW.
- In addition to the influence of government into the infrastructure delivery pipeline there are also challenges associated with arrangement of several jurisdictions having independent boards who will develop pipelines that drive more immediate improvements to revenue vs longer term economic benefits required by government departments.

Impact High

Trend

Inability to access skilled migrants increases competition for talent

- The future infrastructure pipeline in water growing at an average of 6.3% over the next 5 years. This creates significant demand for key resources that are common across other infrastructure groups such as project and program managers, commercial managers and cost estimators.
- The restrictions of COVID-19 on international migrants. 30% of the labour resources for infrastructure at Sydney Water have been sourced from the UK. These include project managers, project engineers and project schedulers. The same resources will be required in other local infrastructure projects such as health and transport, where demand for local talent has grown steadily over the past 5 years. This will continue to have an impact on available resources for water and other infrastructure as they all compete for those same resources. The impact will be rising cost of labour and therefore projects, as well as a reduction in the quality of people leading projects in a scarce environment resulting in potential for more mistakes and costly/timely fixes.
- The significant amount of dam infrastructure in the future pipeline also creates a risk of shortage of specialist engineers in this field.
- This risk can be managed through securing long term partnerships with providers for the future pipeline. As an example based on information from experts in the market sounding, resources have been secured for at least 60% of Sydney Water programs through long term partnerships and recruitment prior to the closure of borders.

Impact High

Trend

Lack of national framework created uncertainty for investment

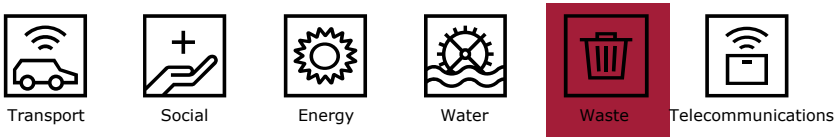
Impact
Critical

Trend

- Market soundings have revealed that water planning on the basis of both short and long term population growth projections is problematic as well as with the changing water dynamics as a result of climate change. With the growth of our major cities consistently underestimated and the challenges of COVID-19 on internal and overseas migration worsening uncertainty with predicting water demand in the next 2-3 years.
- The uncertainty and the associated financial risk can be reduced by allocation of financial risks and returns that enables public and private sector to earn risk adjusted returns. This can be done by:
  - Policy instruments to recover cost of investment and improve financial performance (e.g sanitisation and water supply tax)
  - Identification of permanent revenue stream such as charges on drinking, waste and industry usage
- Market proponents and climate projections both suggest that Australia's water future is uncertain given an inevitable population growth (particularly in major cities) and increasing variability in rainfall.
- As such a reliance on rainfall to fulfil water demands of densely populated regions is a critical risk and current investment in dam infrastructure does not account for this.
- Market proponents have agreed that the water sector requires a clear policy on the future vision for water, one which highlights the need for decentralisation in water systems and increased use of recycled water.

Section 5.6

Waste risks



Few waste projects were developed in recent years, underscoring key challenges with developing circular economy infrastructure quickly enough

Relatively few waste to energy projects have been delivered in recent years in Australia, with the Kwinana Waste to Energy Plant being the first such project to be delivered.

Recent national waste export bans and state and national policy development place a very strong incentive for 'catch up' investment in circular and waste processing infrastructure in coming years.

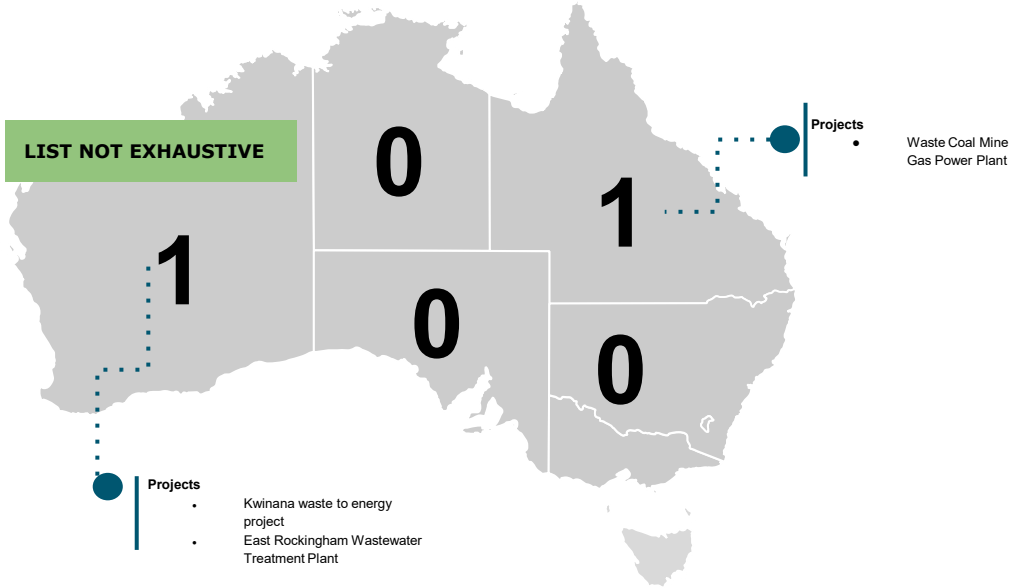
Recent project developments prove ongoing community concern and social licence issues surrounding infrastructure development in this sector, which carries forward into the immediate pipeline of projects.

The analysis identified the following four high risks:

- Community apprehension towards waste infrastructure can delay projects.
- Inadequate infrastructure development coordination for all stages of the waste cycle, from collection to aggregation to treatment.
- Demand for waste management is not being met by investment in waste infrastructure.
- Potential health risks to construction workers and future workers/community due to malfunctions or poor construction.

These critical risks are detailed further in this section.

Recent completions



The future waste pipeline will benefit from a stronger national and state focus on circular economy infrastructure, with policies that increase market demand

This sector includes infrastructure projects that utilise waste to energy technology, anaerobic digestion and other biomass solutions to divert landfill and to retain value from waste are underway.

The Kwinana Waste to Energy plant (Avertas Energy) in Western Australia is the first utility scale waste to energy plant built in Australia. This has likely improved appetite and confidence for this class of infrastructure, and there now are around 20 projects in development on the eastern seaboard.

Future waste infrastructure projects will continue to focus on the development of waste to energy recovery, with multiple facilities being developed across Australia in coming years, including both energy from waste and waste processing facilities.[2]

Waste projects are a small proportion of the national infrastructure pipeline, however the number of waste projects in development is larger than at any point in recent years.[2]

Risks are not abating as yet. Policy uncertainty still exists, although policy and regulatory development are underway, and remaining risks are critical for near-term waste infrastructure development in Australia.

Over $2B for waste facilities

Future pipeline

Project type	Project name
Energy from waste	Kwinana Waste to Energy plant
	Parkes Materials Recovery and Energy from Waste Facility
	Western Sydney Energy and Resource Recovery Centre
	East Rockingham Waste to Energy project
	Swanbank Waste to Energy Facility
	Australian Paper Energy from Waste Facility
Waste processing	South East Melbourne Advanced Waste Processing Facility
Other	Renewable Crude Oil Production, Gladstone
	Renergi Biorefinery demonstration plant
	Malabar Biomethane Injection Project

Unclear planning and regulations, alongside a lack of community support is creating uncertainty within the waste sector which is driving risks

Inadequate infrastructure development coordination

Impact Critical

Trend

- In December 2020, the Australian Parliament passed legislation to ban the export of unprocessed waste overseas. The Act implements a COAG ban on exports of waste plastic, paper, glass and tires, building impetus for developing circular economy infrastructure, alongside policies being developed by all Australian governments.
- Nonetheless, Australia remains far behind other countries such as Norway and Denmark on rates of resource recovery. Historically inexpensive landfill levies and waste exports reduced economic incentives for long term investment in onshore facilities. Immature end markets also mean there is a lack of demand for the use of recycled materials. And the oversupply of materials that followed the ban drove down the price of materials for recycling, to zero for paper and less than 25% of the previous value for plastics, creating a significant challenge for local councils to fund their recycling programs.
- The risk is that continuing market failures will lead to a shortfall in the scaled planning and development of critical infrastructure, including waste to energy but also aggregation and collection facilities. This would lead to the diversion of a far great amount of landfill, and is pronounced given the length of time such projects take to develop. For example, Kwinana took 10 years to develop.

Community concerns delay planning approvals

Impact Critical

Trend

- Many proposed waste projects have failed due to community opposition, which has led to significant planning delays and failure.
- The ACT introduced a ban on waste incineration in response, after a proposal to build a W2E projects in Fyshwick was withdrawn.
- In 2018, a waste project proposed for Eastern Creek was refused on the basis of uncertainty over human health concerns and air quality.
- The Next Generation Pty Ltd proposal is awaiting consideration by the Land and Environment Court
- While waste technologies have improved to capture emissions released from combustion of materials such as plastic, to utilise residues and to manage smells, ongoing concerns include increased truck traffic and amenity impacts. However, the urge to locate waste infrastructure further away from residential areas has serious implications for the infrastructure required and for higher transportation costs.

Security and scale of supply for waste to energy projects

Impact Med

Trend

- A major challenge to the development of commercial scale waste to energy projects in Australia is the ability to secure bankable, reliable quantities of waste for energy production and/or other byproducts. Facility operators may also need to respond to changes in feedstock volume or composition over time.
- Municipal waste is typically contracted by councils from a larger regional or national private waste service operators. These service contracts are low margin, high volume contracts with varying contract lengths.
- Analysis of successful energy from waste markets, such as Europe, highlight examples of local councils combining waste quantities to achieve scale, and locating projects close to major waste sources, and to points of grid connection.

$13.8B

Value of the solid and liquid waste collection, waste remediation and recovery, and waste treatment and disposal industries.[56]

Kwinana Waste to energy plant:

- 25% reduction in waste going to landfill
- 486,000 tonnes of CO2 avoided through reduced demand on traditional energy sources and avoided methane gas from landfill
- 36MW of power, sufficient to power 50,000 homes

Low levels of market and regulatory readiness

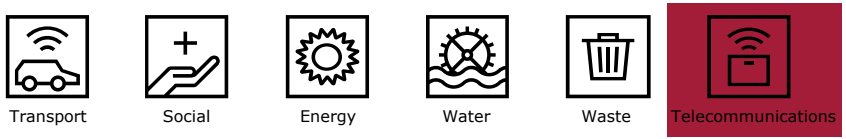
Impact High

Trend

- As a nascent segment of the infrastructure market, there remain several areas of low market and regulatory maturity. These include:
  - **Complementary Regulation and Investment:** In addition to planning approvals, energy to waste projects require a suite of support to ensure feasibility such as changes to landfill charges, clarity around the waste hierarchy in to recycling, and upstream changes to collections and processing of waste.
  - **Planning Law:** The Waste Recyclers Association of NSW in their submission to a Federal Parliamentary Inquiry noted that "...[a] *lack of clarity around planning laws, outdated waste management laws and a poorly educated community has long stifled innovative solutions in energy from waste across Australia. The industry requires clearly defined, agreed and acceptable timelines for the processing of planning applications for new waste [and] recycling facilities. The industry also requires government support to progress suitable, best practice applications"*.
  - **Contractor and operator experience:** There is currently only one civils contractor with experience to build these types of projects. Appetite is growing however, but these remain risky projects with minimal familiarity within the market in terms of sub-contractors, trades and unions. Operator risks remain untested in the Australian market.
  - In relation to the development of recycling and small scale resource recovery infrastructure, factors such as contamination and low quality materials collection inhibit the investment signals required. This will likely require a great level of coordination across all levels of government.

Section 5.7

Telecommunications and digital risks



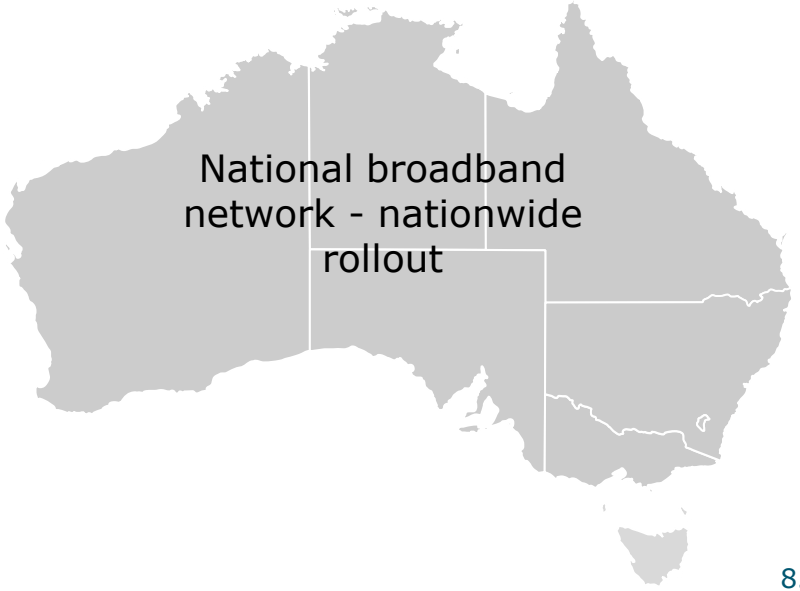
Investment in digital infrastructure was dominated by the roll-out of the NBN in recent years.

The NBN (revised) build was completed in 2020, with NBN Co reporting that the build provided successful connecting of over 11.86 million premises, and around 100,000 complex premises yet to be made 'ready to connect' (RTC), expected to be reduced to around 35,000 as at 31 December 2020.

While the roll out was subject to policy / design changes, and late construction deadlines, the overall construction build was delivered reliably. In 2020, additional capacity was released to ISPs during the lockdowns to meet increased demand from working from home activity.

There is also analysis of data from Oxford Global Projects on digital and IT infrastructure projects.

Recent completions



The Oxford Global Projects database indicates that larger digital and infrastructure projects have greater schedule and cost overruns

Cost overruns

Larger IT projects (those greater than $350m) had statistically significantly higher cost overruns as compared to smaller projects, with the average large projects having cost overruns 4 times as large as small projects (264% vs 68%)
The median cost overrun in both groups was 0%, which highlights that when large IT projects go bad, they tend to have proportionally much larger cost overruns.

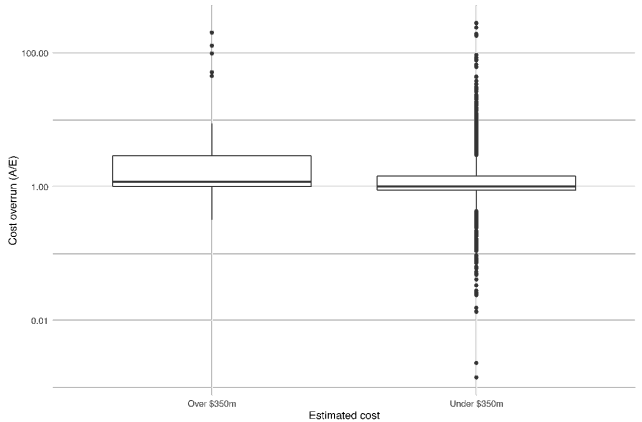


Figure 42: Cost overruns for digital projects above and below $350m.
Source: Oxford Global Projects, 2021

Schedule overruns

Globally, IT projects over $350m also had statistically significantly higher schedule overruns as compared to smaller projects, however due to small sample sizes this relationship may be tenuous.
Smaller projects however had longer schedule overruns in the extremes of the distribution as compared to larger projects, however this is likely due to the absolute schedules of smaller projects being much shorter, which allows for such overruns (e.g. a 2 month projects taking 2 years to deliver is possible, while a 2 year project taking 10 years to deliver is not possible).

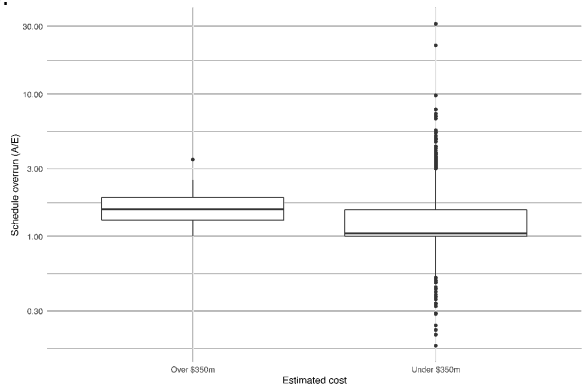


Figure 43: Schedule overruns for digital projects above and below $350m.
Source: Oxford Global Projects, 2021

Australia's next stage of digital infrastructure development will need to address gaps in network performance, and regional and remote connectivity

The Australian Government has set clear objectives in the context of its second stage of its NBN infrastructure rollout, to be a digital Top 10 Economy by 2030.

While the NBN (revised) build was completed in 2020, FTTN and speed caps on packages have meant that the portion of Australians able to access promised internet speeds remains relatively small, especially in regional and remote areas.

A recent announcement by NBN Co will deliver its next phase of investment by 2023. This will involve:

- $3.5b to deliver to 75 % of homes and businesses in the fixed-line footprint peak wholesale speed tiers of 500 Mbps to close to 1 Gbps1.2
- $700m in initiatives with retail internet providers, including in regional centres
- $300m in support for state and territory partnerships in regional and remote Australia.

These comprise around the smallest proportion of the national infrastructure pipeline in terms of the number of projects of the infrastructure pipeline.

A number of state government have initiatives 'Gigabit programs' that provide additional investment and support.

In the next five years, a number of private programs of investment will also be delivered, with favourable coverage in metropolitan areas.

Future pipeline

Victoria's Digital Future Now
$626m of investment to improve mobile and broadband coverage across the state

NSW's Regional Digital Connectivity program
$400m of investment to improve access to mobile, digital, and internet services across regional NSW

Tasmanian Radio Network
$567m to upgrade Tasmania's radio network used by emergency responders and government organisations when responding to emergencies

National Broadband Network
Over $4B to improve network speed and connectivity across the nation

There are risks driven by underinvestment, declining returns for telcos and insufficient priority on digital aspects of infrastructure projects

Underinvestment and affordability challenges with network infrastructure

Impact High

Trend

- There is an emerging risk of underinvestment in digital infrastructure relating to the fibre and 5G infrastructure required to deliver against the Australian Government's goal of being a leading digital economy by 2030 - and questions of whether investments needed to 'future proof' the network are affordable.
- The impact of this underinvestment puts at risk a potential **$90b in GDP growth** over the 5 years to 2025 and $230b over a 10 year horizon and the ~250,000 jobs enabled by this digital transformation and the supporting competitiveness of organisations.[60] Additionally underinvestment in digital infrastructure is likely to impact through greater cyber security attacks, limiting the ability to combat them.
- This is partially being mitigated by the investment in future fibre to premise roll-outs by the NBN and state based investments, however this is unlikely to ensure complete coverage for all Australians, particularly those in remote areas and smaller towns.

Lack of market incentive to improve Rural and Remote Access

Impact High

Trend

- Significant issues remain in rural and remote areas for mobile and broadband services.
- Geography also matters in terms of the cost of providing telecommunications infrastructure in rural and remote settings, and the returns reduce as population densities decline.
- While Australia's mobile footprint includes over 99% of the population (at their premises), it covers only one-third of total landmass, meaning little or no service for those working and travelling in rural and remote areas.[62]
- With introduction of 5G this gap will be wider as the new rollout prioritises high density / greater return areas over rural areas.

Farmers have varying levels of coverage across their properties

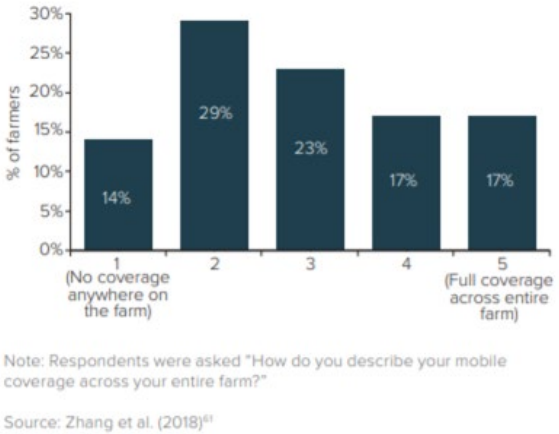


Figure 44: Level of coverage across farmland.
Source: Zhang et al., 2018

Declining returns on private investment and 'free rider' issues for 5G

Impact: Medium

Trend: ↓

- There is a growing risk to the expansion of the 5G network in Australia relating to declining profits from investors from the network. PwC experts indicate that return on capital is now around 6-8% and declining, compared with double digits historically.
- The 5G network requires approximately 10x the density of infrastructure towers compared to 4G requiring significant investment by mobile operators. There is a risk to this investment as the revenue derived from 5G benefit is likely to be captured by the application providers such as Google and Microsoft with the cost of investment lying with mobile providers and limited ability to increase consumer plans to cover the infrastructure roll out cost.[63]
- A McKinsey report into 5G in 2018 and the underlying analysis indicated that revenues were flat for mobile providers from the rollout of 4G and this is anticipated to be the same for 5G.[63]
- The impact of this risk manifesting could be significant, particularly for regional and remote areas where the return on investment for mobile providers is harder to achieve. This will adversely impact businesses unable to access applications and tools built for 5G speeds as well as communities who may need to access education or health services using the newer technology.

Poor understanding of existing utility infrastructure

Impact: Critical

Trend: ↑

- There is an existing but growing risk associated with digital components of projects not being treating with the same level of importance as the civil infrastructure in projects.
- New technology and demands from customer and the community to be better connected and have more integrated services will continue to drive the growth of technology and digital aspects within infrastructure.
- Expert and market sounding interviews have told us that the capabilities, regulatory systems and project governance are not yet sufficiently geared to ensure that infrastructure projects are appropriately focussed on the digital/technology aspects. Once respondent told us *"The safety and regulatory environment is not well adapted to for the wave of digital orientated infrastructure coming."*
- This risk is particularly prevalent in the Transport. industry with projects relating to train control and signalling systems as well as smart motorway projects, however this is prevalent across critical infrastructure areas and will continue become more prevalent. This has implications for integration as well as cybersecurity.
- The impact of not giving sufficient focus to the digital aspects can lead to significant cost overruns and project delays. In the case of Crossrail in the UK, this project is delayed by at least 2 years and at least 10% of 2 billion pounds over budget, which is, at least in part, attributed to digital challenges and a lack of focus on these components sufficiently early in the project.

APPENDIX

6.1 Reference list
6.2 Data sources
6.3 Risk taxonomy

6.1 - Reference List

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6.2 - Data sources

In addition to Infrastructure Australia data, a number of databases were used in the preparation of this report. Although not explicitly referenced, a number of risks were identified and tested through an analysis of these databases.

	Name	Description
1	Oxford Economics, Australia Risk indicators	Risk indicators for Australia by quarter
2	Fitch Solutions, Infrastructure Key Projects Data	Includes data on 36,000+ projects globally. The Infrastructure Key Projects Data (KPD) is a comprehensive catalog of the largest construction projects around the world. Currently the database stores projects in over 200 markets across the energy and transport infrastructure sectors, as well as the residential and non-residential building sectors. It compiles data from a comprehensive list of national and international open sources and renders the information in an accessible, standardised and searchable format.
3	Fitch Solutions, Australia infra risk reward	Reward Index (RRI) quantifies and ranks a country's attractiveness within the context of the Infrastructure industry, based on the balance between the Risks and Rewards of entering and operating in different countries. https://app.fitchconnect.com/libs/pdf-viewer/web/viewer.html?file=/excel-plugin/FS_RRI%20Meth%20Infra.pdf
4	Fitch Solutions, Australia infra project risk	The Index assesses the risks on a country-by-country basis; it does not evaluate specific projects. The tool is applicable to all types of infrastructure projects, including transport, energy and utilities, and social infrastructure, and looks across the life cycle of a project, from financing through to tendering, construction and operation. https://app.fitchconnect.com/libs/pdf-viewer/web/viewer.html?file=/excel-plugin/FS_Project%20Risk%20Index%20Methodology.pdf
5	Global Infrastructure Hub, PPP Risk Allocation Tool	The PPP Risk Allocation Tool serves as a reference guide for governments and other relevant stakeholders in deciding on the appropriate allocation of project risks in a given PPP project, as well as potential risk mitigation measures. The guide is made up of 18 annotated risk allocation matrices each specifically tailored to a given project type (such as a road, airport, solar plants or hospital project). The tool is downloadable in PDF in English and Portuguese.
6	S&P Global, Trucost Physical Risk NOTE: A sample dataset was explored	Trucost's Physical Risk dataset assesses company exposure to physical risk at the asset-level based on a database of over 500,000 assets mapped to 15,000+ listed companies in the S&P Market Intelligence database. The dataset includes: - Seven climate change physical risk indicators including heatwaves, cold waves, water stress, hurricanes, wildfires, flood and sea level rise - Low, moderate and high future climate change scenarios based on the Intergovernmental Panel on Climate Change (IPCC) Representative Concentration Pathways (RCP) - Estimates of climate change physical impacts in 2020, 2030 and 2050
7	IBIS World, COVID-19 Impact Tool	COVID-19 is forcing businesses to quickly change their strategy to uncover new opportunities. To assist with decision making during the current crisis, IBISWorld created a tool to help you understand different industries' levels of vulnerability to COVID-19 exposure factors. Within the tool you can easily identify an industry's exposure to: Working from home capabilities Social distancing Macroeconomic factors Trade exposure Labour intensity Supply chain exposure These factors can be supplemented with our industry research to help frame your decision making surrounding: Identifying new markets Protecting your position Developing and strengthening a strategic plan
15	BITRE, Australian Infrastructure Statistics - Yearbook 2020	Overview of statistics on infrastructure broken by transport, communications, energy and water. Dashboard also available
16	Marsh & McLennan, Global Risks for Infrastructure	Listed here are key markets and their top-ranked risks, as per the WEF's Executive Opinion Survey (EOS) of 12,879 business executives from 133 economies. This survey was completed in 2019. The WEF dataset omits data for China, Georgia, Honduras, Mauritania, Nicaragua and Saudi Arabia. The EOS 2019 was not conducted in Belgium and Norway
20	WA Water, Flood data - WA	Spatial data on flood plains in WA. Note: Datasource was not downloadable.
21	Flood data - QLD	Spatial data on flood plains in QLD. 1 layer without detail on levels, likelihood, etc
22	DataVic, Flood data - Vic	Has details on likelihood, Extent_{n}y_ARI, where n = 5,10,20,30,50,100,200,500,1000 year intervals Modelled Flood Contours: Contour_{n}y_ARI, where n = 5,10,20,50,100,200 year intervals Other flood datasets: Floodway, Historic_extents, Historic_height_pt, Historic_contours, Flow_direction, Flood_structure, Levee, Levee_spotheight, Running_distance.
23	Water Connect SA, Flood data - SA	Spatial data on flood plains in SA. Note; datasource was not downloadable
24	Department of Environment, Parks and Water Security, Flood data - NT	Spatial data on flood plains in SA. Note; datasource was not downloadable
25	Flood data - NSW	Spatial data on flood plains in NSW. Note; datasource was not downloadable

6.3 Risk taxonomy

The following is a description of the terms that will be utilised in the risk assessment framework. Having a common taxonomy in place will assist with ensuring consistency in the application of risk identification, assessment and treatment processes. It will also assist with normalising risk data that will be sourced from the different state based I-bodies and delivery agencies.

Term	Definition
Asset type	The type of asset that the risk relates to (e.g. roads, universities, hospitals, fuel connections / gas pipelines, irrigation systems / schemes, NBN, disaster resilience - flood mitigation).
Funding model (e.g. PPP)	The funding model used to support/resource the project that the risk relates to (e.g. public-private partnership).
Geographic location	The geographic location/area where the risk / project exists.
Issue	A risk that has eventuated / occurred and now has a negative impact.
Macro or project level risk	Whether the risk is categorised as a macro or project level risk. Macro risks are those associated with wider environmental factors impacting the delivery of project outcomes. Project level risks are those specific to the project and may impact the achievement of planned outcomes.
Public / private sector	Whether the project that the risk relates to is owned by the public or private sector.
Response event timing	When the risk event occured in the project lifecycle.
Risk	Risk is the effect of uncertainty on objectives. • Risk is often characterised by reference to potential events and consequences, or a combination of these • Risk is often expressed in terms of a combination of the consequences of an event (including changes to circumstances) and the associated likelihood of occurrence.
Risk category	A more detailed classification of the category that the risk falls under. This sits under the risk class as a second level of detail. Like the risk class, these categories should be decided by Infrastructure Australia to reflect the nature of the projects / risks.
Risk class	A high level classification of the type of risk. Risk classes should be decided by Infrastructure Australia to reflect the nature of the project / risks.
Risk conversion to issue (Y/N)	A “Yes” or “No” response on whether the risk has developed into an issue (i.e. has the risk eventuated / occured?).
Risk description	A description of the risk giving context and a high level explanation of the impacts / consequences of the risk, should it occur.

Risk taxonomy (cont.)

Term	Definition
Risk event	An occurrence or change of a particular set of circumstances. An event can sometimes be referred to an "incident" or "accident".
Risk event timing (project lifecycle stage)	The stage of the project lifecycle in which the risk event would occur (e.g. the risk would eventuate in the planning / design / operations phase).
Risk management	The coordinated activities to ensure that risk is identified and analysed to inform decision making.
Risk management framework	The set of components that provide the foundations and organisational arrangements for designing, implementing, monitoring, reviewing and continually improving risk management throughout the organisation
Risk rating	The overall risk assessment and RAG status, determined through the likelihood and risk impact assessments. This is measured using the risk assessment matrix (refer to page 13).
Risk root cause	The element which alone, or in combination, has the intrinsic potential to give rise to risk.
Risk/issue impact category	A detailed classification of the impact of a risk (or issue). Like the risk category, these categories should be decided by Infrastructure Australia to reflect the nature of the projects / risks. Risk categories should include financial, safety (life and limb), customer service, staffing and culture, compliance with regulation / law and reputation (refer to page 12 for further details).
Sector	The area of work that the risk relates to (i.e. transport, social infrastructure, energy, water, telecommunications project or other).
Stage in project lifecycle	The stage of the project lifecycle that the risk is relevant to (i.e. planning, design, engineering, construction, handover, operations, maintenance or disposal).
$ size of project	The monetary size of the project.

Risk assessment matrix - Likelihood definitions

Effective risk identification and management includes an assessment of risks based on the likelihood and impact/severity of the risk eventuating. Below are the risk likelihood scores and criteria to guide Infrastructure Australia's risk management.

Score	Probability	Description
1. Rare	<=10%	Risk may occur only in exceptional circumstances during the life of the project or phase.
2 . Unlikely	>10% - 30%	Risk is not generally expected, but could occur during the life of the project or phase.
3. Possible	>30% - 50%	Risk might not, but is likely to occur at some time during the life of the project or phase.
4. Likely	>50% - 75%	Risk will probably occur in most circumstances during the life of the project or phase.
5. Almost certain	>75%	Risk or issue is occurring now, or expected to occur during the life of the project or phase.

Risk assessment matrix - Impact definitions

Effective risk identification and management includes an assessment of risks based on the likelihood and impact/severity of the risk eventuating. Below are the risk impact/severity assessments and risk impact scores to guide Infrastructure Australia's risk management.

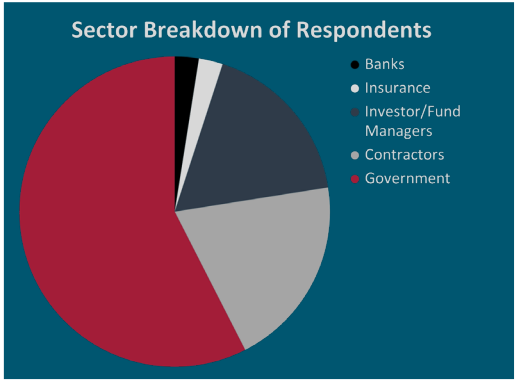
Score	Risk impact/severity					
	Cost / Financial	Schedule	Sustainability/ environment	Reputation	Quality	Safety
1 Insignificant	<=2% of project budget / benefits	Schedule delay < 1 month or <5% of total schedule	Temporary contamination (days) to land, air, groundwater or surface water environment to immediate area around asset or activity. No lasting impact (days) on species, habitat, community amenity or heritage sites. Self reporting or notification to relevant regulatory bodies.	Local complaint, no media coverage. Quickly forgotten with freedom to operate unaffected.	Requires minor improvements, however within quality thresholds. No impact on project success.	Slight and recoverable injury or discomfort requiring first aid response with no follow up required if any employee, visitor or contractor.
2 Minor	>2 - 5% of project budget / benefits	Schedule delay >1 month - 2 months or >5 - 10% of total schedule	Minor contamination to land, air, groundwater or surface water environment (clean up / recovery of a localised event within weeks). Minor impact on species, habitat, community amenity or heritage sites (restoration within weeks). Enforcement action undertaken by relevant regulatory bodies in the form of a warning	Localised complaints that can be managed to achieve an effective outcome. Limited, adverse local media attention (single instance). Negligible impact to reputation with freedom to operate unaffected.	Project outputs are outside of quality thresholds, and may impact the achievability of an objective requirement.	Event resulting in injury or disease that resulted in a treatment given by a medical practitioner but without permanent disability of any employee, visitor or contractor.
3 Moderate	>5 - 10% of project budget / benefits	Schedule delay >2 months - 6 months or >10 - 20% of total schedule	Serious contamination to land, air, groundwater or surface water environment (clean up / recovery within 1 year). Moderate impact on species, habitat, community amenity or heritage sites (restoration within 1 year). Enforcement action undertaken by relevant regulatory bodies in the form of a Penalty Infringement Notice (or similar)	Public outcry (sustained and numerous customer complaints including online). Adverse state media coverage (1 to 2 days). Limited, repairable damage to reputation. Some concern on relations with key stakeholders (explanation required).	Project outputs are outside of quality thresholds and require moderate changes. At least one project objective is at risk.	Event causing a serious or permanent injury or long-term illness with immediate admission to hospital of any employee, visitor or contractor.
4 Major	>10 - 20% of budget / benefits	Schedule delay >6 months to 1 year or 20 - 30% of total schedule	Very serious contamination to land, air, groundwater or surface water environment (clean up / recovery 1 to 4 years). Major impact on species, habitat, community amenity or heritage sites (restoration period 1 to 4 years). Enforcement action undertaken by relevant regulatory bodies in the form of an enforceable undertaking or court prosecution	Serious public outcry (community action or protests, including online) (2 to 3 days). Adverse state media coverage (2 to 3 days). Negative impact to reputation but repairable (within 1 year). Adverse impact on relations with key stakeholders (expressed displeasure)	Project outputs are unacceptable. Significant changes are required, and several project objectives are at risk.	Event causing single fatality and/ or total and permanent disability of any employee, visitor or contractor.
5 Extreme	>20% of project budget / benefits	Schedule delay >1 year or >25% of total schedule	Permanent, widespread and irreversible contamination to land, air, groundwater or surface water environment. Permanent loss of species, habitat, community amenity or heritage sites Enforcement action undertaken by relevant regulatory bodies.	Very serious public outcry (community action or protests, including online) (3+ days). Sustained negative media coverage at state or national level (3+ days). Lasting impact to reputation (1+ year). Critical impact on relations with key stakeholders (loss of support)	The project outputs are not fit for purpose and will not deliver the planned benefits/outcomes.	Event causing two or more fatalities and/ or permanent total disability of any employee, visitor or contractor.

Overview of the market sounding survey

- 40 market participants across government, contractors, debt and equity funds participated in a market sounding survey designed to understand how market participants view:
  - the risk profile associated with the future infrastructure pipeline;
  - the most critical risks associated with the future pipeline and the party more appropriately positioned to take on these risks; and
  - the confidence in the market to adapt to a sudden increase in infrastructure projects.
- 93% of participants had over 6 years of experience in infrastructure with over 35% having national coverage.

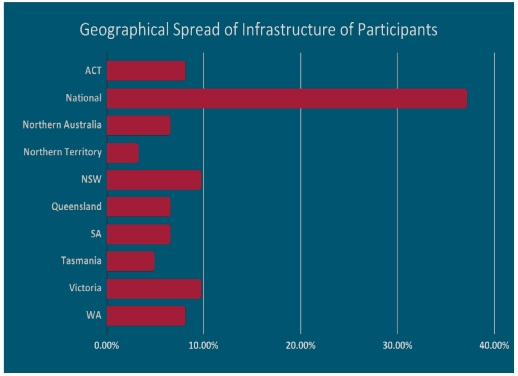
40

40 market participants responded to the market sounding survey.



>6yrs

All participants were executives or managers in their respective sectors and 93% had more than 6 years of experience in Australian Infrastructure.



Overview of the market sounding interviews

- **Critical Risk Assessment:** What are the critical risks to the financing, development and delivery of infrastructure? How do these vary across asset class (transport/health/energy), project types and project size?
- **Changing risk dynamics:** How are these risks evolving, and are they different today than they were 2-3 years ago? What is the future risk landscape?
- **Which projects are most risky / least risky?** Please compare across sectors and geographical locations
- **Risk sharing:** Considering the most critical risks, who is best placed to bear these? Are these typically properly priced?
- **Risk contracting:** What is your current appetite to lend into infrastructure PPPs and other privately financed projects? Are there impediments?
- **Recent risk performance:** How have recent PPPs performed, in transport and social infrastructure, from financing to full operation PPPs? Which have been most prominent in recently completed projects?
    - Utilities / in ground risks
    - Interface risks (third parties) - in construction
    - Tunnelling (ground conditions) - generally not financed
    - Patronage/demand - WestConnex; transferred on toll road;
    - Activity based prices (health)
- **Mitigations:** How well are risks understood and mitigated in Australia/Northern Australia, relative to practices elsewhere?